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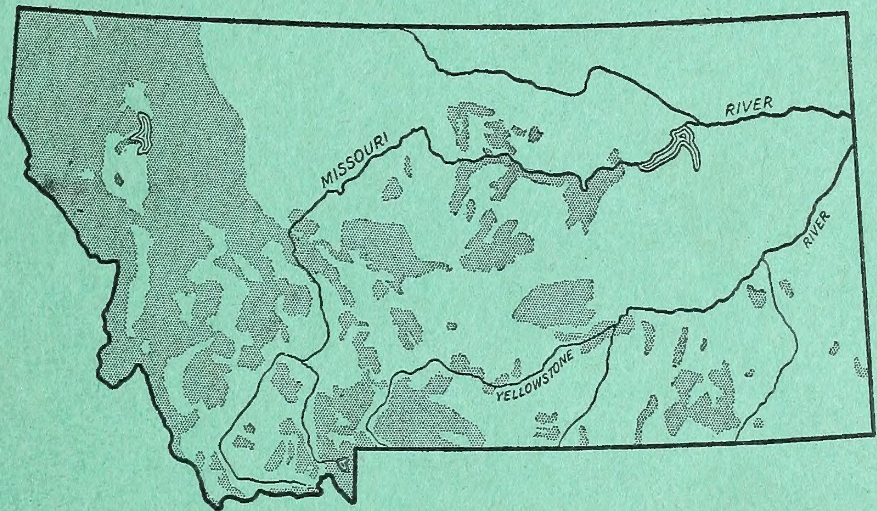
FOREST RESOURCES of MONTANA



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a FOREST RESOURCE REPORT NO. 5 WASHINGTON, D. C., 1952

3

FORESTRY RESOURCES OF MONTANA

[by]

LC 2

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Preface

In 1928 Congress passed the McSweeney-McNary Forest Research Act authorizing a comprehensive survey of the timber supplies in the United States. Responsibility for this survey was assigned to the Forest Service of the Department of Agriculture. The work in Montana has been under the direction of the Northern Rocky Mountain Forest and Range Experiment Station. This is a report on the findings of the Montana survey.

The job of inventorying the extensive forest of Montana and collecting growth and drain information was begun in 1934. Before its interruption by World War II the survey was completed for that part of the State west of the Continental Divide and in four counties east of the Divide. Field work was resumed in 1947 and completed in the fall of 1949.

The inventory, growth, and drain figures presented are the first based upon a complete systematic survey of the timber resource in Montana. It is hoped that these data and the analysis in this report will help increase the contribution of this timber resource to the economy of Montana and the United States.

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The Facts In Brief

How much of Montana is forest?

One-fourth of the State, or 22,359,000 acres, is classified by the Forest Survey as forest land. The total area of the State is 93,642,000 acres. Fifty-eight percent of the forest area lies in the one-sixth of the State that is west of the Continental Divide.

How much of the forest is suitable and available for timber production?

Seventy percent of the forest land, or 15,756,000 acres, is "commercial," i. e., suitable and available, now or prospectively, for the production of timber for industrial use. This represents about 3½ percent of the total commercial forest in the United States.

How much saw timber is there?

Montana's commercial forest contains 56 billion board feet of timber, likewise about 3½ percent of the national total. Approximately half of the saw timber is of two species: larch and Douglas-fir. Ponderosa pine, Engelmann spruce, and lodgepole pine are other important species from a quantity standpoint. Seventy-one percent of the saw-timber volume is west of the Continental Divide.

Who owns the forest?

Seventeen million acres, or 76 percent of the total forest area, is publicly owned or managed. The national forests alone include 13,923,000 acres of forest. Public agencies manage only 69 percent of the commercial forest. Seventy percent of the current saw-timber volume is publicly owned or managed.

How fast is the forest growing?

For the primary growing stock, that is all trees 5.0 inches and larger, the annual net growth is 241 million cubic feet. The net saw-timber growth is 606 million board feet a year.

Is the growth rate satisfactory?

No, not from a long-time standpoint. The net growth on primary growing stock amounts to only 15 cubic feet per acre a year. It should be possible to double this rate. The saw-timber growth amounts to only 38 board feet per acre a year, compared to a potential of 85 board feet.

How can growth be increased?

Gross growth can be increased by restocking deforested areas, improvement cuttings in thick young stands, and by replacing the extensive areas of old, decadent forests with vigorous rapid-growing, well-stocked stands. Net growth can be increased by reducing the high mortality losses from fire, insects, shading, and other natural causes which are all debits against gross growth. To illustrate, annual gross growth is 849 million board feet, but 243 million of it is offset by mortality.

Does the high mortality rate indicate inadequate protection?

Progress has been made in curbing fires. Corresponding effort has not gone into insect control. Because of the low vitality associated with advanced age, much of Montana's timber has suffered heavy losses from bark beetles. These losses will diminish as the old trees are utilized, but in the meantime they can be reduced only by intensifying insect-control efforts.

Is the timber cut too high or too low?

With some important exceptions, the timber cut in the State has been too low. The allowable annual cut of saw-timber and pole-timber trees and the usable portion of cull and dead trees in Montana is 129 million cubic feet greater than the cut in 1948. One exception to the over-all situation is the ponderosa pine saw timber, which has been drastically overcut for a number of years. Also, the 1948 cut of larch and Douglas-fir saw timber was somewhat larger than desirable.

How can timber utilization be increased?

Most important of the needed developments in Montana is roads. Insect-control activities to save old timber will pay off only if the timber saved can be hauled out. That requires roads. Timber killed by one cause or another can only be salvaged if there are roads. Roads are also necessary for industrial development. The permanent road network required for administering the Montana national forests is only 13 percent completed.

Does Montana need more forest industries?

Yes. However, not just any industry will do. There are already more than enough customers for the valuable ponderosa pine and white pine. We need more plants, such as pulpmills that will use sizes and species of timber and parts of trees not now in much demand, and we need better distribution of the cut over the entire State.

Has lack of roads been the only factor holding back industrial development?

No. Lack of roads is actually the effect of a more fundamental difficulty. Montana has suffered the handicap of remoteness from markets; high transportation cost has slowed the growth and development of the State.

The heavy wood consumption in the United States preceding and following World War II, plus the population growth in the West, has increased the value of Montana timber. Prospects are favorable for increasing industrial use of the timber in years to come.

What is the place of the forest in Montana's economy?

Water, recreation, forage, and timber values in Montana loom up very large and can, if the forest is managed properly, make a major contribution to the economy of the State.

One of the more significant points in this report is that the timber-producing capacity of the 15,756,000 acres of Montana's commercial forest is far greater than many people had realized.

The Place of the Forests in the Economy of Montana

In 1948 the average income per individual in Montana was $1,696. This is a very significant figure for it is the highest on record for the State up to that time, and 22 percent higher than the national average in 1948 (*16*).[1] Montana has not always ranked so high (fig. 1). Since 1928 it has ranked as low as twenty-eighth among the States in per capita income, and it fell from fifth place in 1948 to eighteenth in 1949. Though all States have had their ups and downs, instability has been a greater problem here than in most of them.

By and large, the principal objective of those who are thinking of Montana's future is to achieve the stability which figure 1 shows to be lacking, and to stabilize income at a high level. Among other things, this means capitalizing fully on the resources available. One of the more important of Montana's natural resources is the forest.

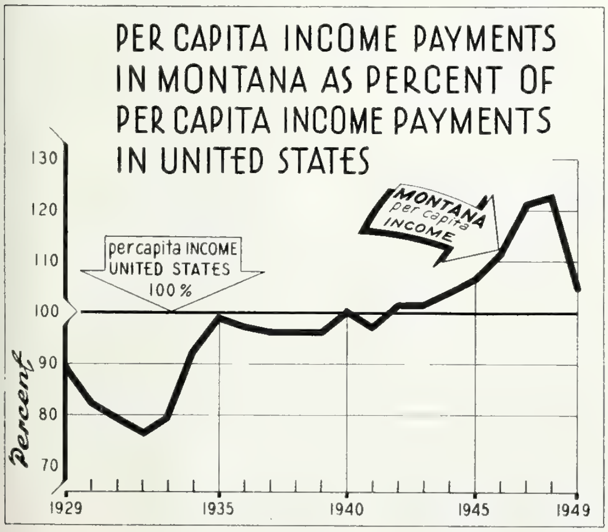

Figure 1.

There are 22 million acres[2] of forest land in Montana, one-fourth of the State, as shown in the following tabulation of land use:

	Million acres
Forest	22.4
Cropland and plowable pasture in farms (1940)	14.8
Pasture range	54.6
Other land	1.8
Total	93.6

It is a vast forest that has produced many benefits, yet has much more to give. This report is concerned primarily with what timber use can contribute to the economy of the State. However, three other important forest values—water, recreation, and forage—are also considered.

Water, timber, recreation, and forage are all products of the same forest, sometimes of the same acre. It has long been one of the cardinal principles of forestry to manage for multiple use. We cannot, for example, afford to make timber the single purpose of management to the extent of sacrificing the other resources. Though the various uses of the forest do not intermesh perfectly, good forest management involves fitting them together so as to provide the greatest composite benefit.

Timber Values In The Forest

More than a century ago white men began hewing at Montana's great forest. Late in the 1840's the first sawmill was set up in the Bitterroot Valley. During the mining boom of the 1860's and following years timber cutting became more widespread, but real industrial development did not begin until transcontinental railroads provided a link with the East and a large market for Montana products (fig. 2).

---

[1] Numbers in parentheses refer to Literature Cited, p. 57.

[2] To permit a ready grasp of the salient forest area and volume statistics, the figures in the text and in the tables included with the text have been rounded off to the nearest tenth of a million acres and tenth of a billion board feet. Exact figures are tabulated in the appendix. Definitions of terms used are given in the appendix also.

Since the time of the first sawmill, a total of nearly 20 billion board feet of saw timber has been logged.[3] That volume is about one-third as great as the total commercial stand in Montana today. Most of the 20 billion board feet went to sawmills where it was cut into boards, planks, railroad ties, and mine timbers.

All together, 434 active sawmills produced 598 million board feet of lumber in 1948. In addition to the sawmills there are several smaller but, nevertheless, important forest industries. Year after year, about 450,000 pieces of round mine timbers are produced for the metal and coal mines. Since World War II Montana's pole industry has produced as many as 325,000 poles annually (1947). During 1949, 53,000 cords of pulpwood were shipped to Washington and Wisconsin. A Christmas tree industry that began a quarter of a centry ago has grown until Montana now leads all other States with its annual production of more than 3 million trees. An estimate of the value of Montana's forest products in 1948 follows:

Lumber	$44,500,000
Round and hewn mine timbers	1,500,000
Christmas trees	1,100,000
Fuel wood	1,000,000
Posts	800,000
Pulpwood	700,000
Poles	600,000
Total	$50,200,000

The importance of the forest industries differs greatly by localities. On the eastern prairie they play an insignificant part in the local economy. Even on the eastern slope of the Rockies where there is a substantial timber area, the forest industries are as yet small. West of the Continental Divide, or in western Montana,[4] however, the forests occupy 81 percent of the land area and furnish a large part of the local income. The 1940 census of agriculture showed that 28 percent of the people classified as farm operators in western Montana

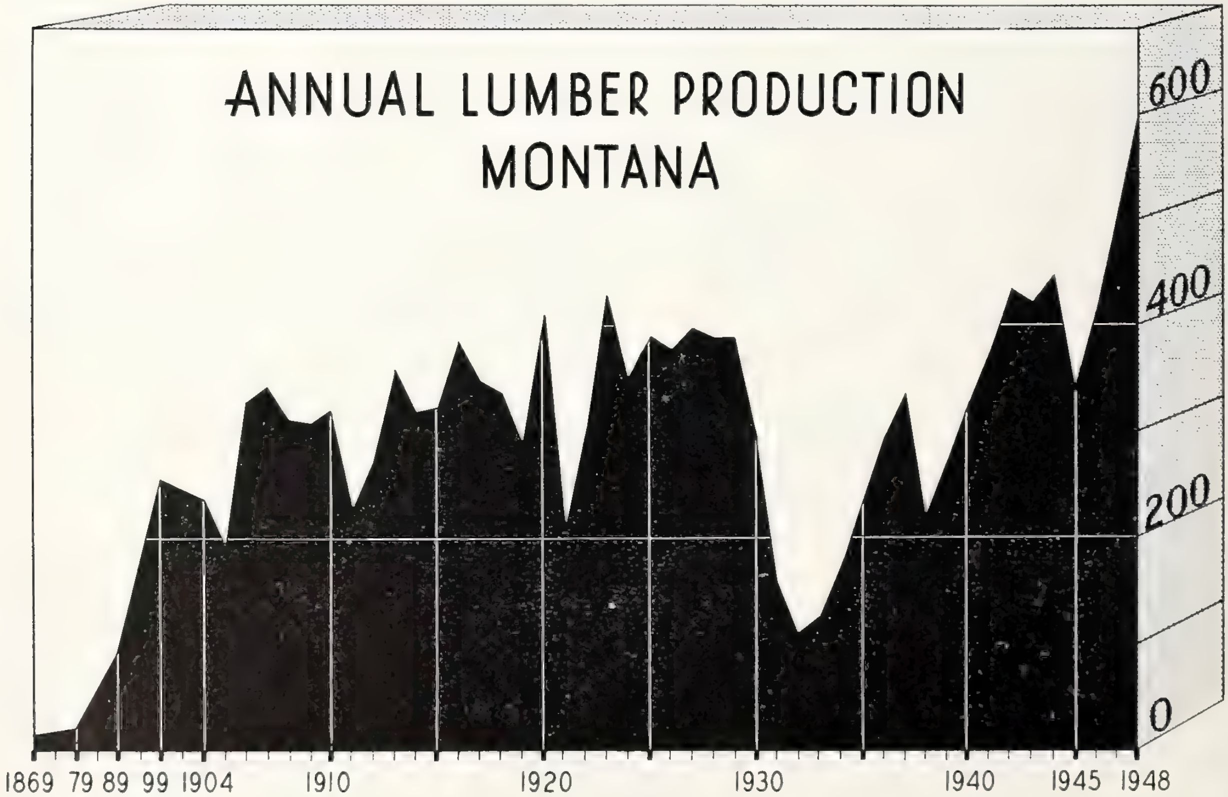

FIGURE 2.

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[3] All of the board-foot stand, growth, and drain figures in this report are based on the International 1/4-inch log rule, which is considered the equivalent of lumber tally.

[4] In this report the area west of the Continental Divide is called western Montana and that east of the Divide, eastern Montana.

worked 50 or more days off their farms the preceding year. Much of the off-farm employment was in producing Christmas trees and in other woods work. A study of Lincoln County in the northwest corner of the State revealed that six-tenths of its basic income is derived from the lumber industry and other forestry work.

For the State as a whole, forest industries rank behind agriculture and mining in both employment and value of products (*9, 14, 17*), as shown by the following:

	Value of products (dollars)
Mineral, 1947	87,200,000
Farm, 1948	393,000,000
Forest, 1948	50,200,000

	Employees in major industries (number)
Mining and metal manufacturing, 1948	14,500
Agriculture, 1945	59,600
Lumber and timber product industry, 1948	5,800
Interstate railroads, 1948	14,400

The income and employment figures do not tell all of the story. An abundant timber supply close at hand has been a tremendous asset in the development of other industries. For example, since hard-rock mining started, 3½ billion dollars worth of copper, lead, zinc, gold, and manganese have been dug from Montana's hills. It took a lot of wood to produce this wealth. Back in the early days thousands upon thousands of cords of fuel wood were cut to keep the smelter fires roaring (fig. 3). Now that other fuels are used in smelting, the main use for wood is in underground timbering, without which it would not be possible to go deep into the earth for metals.

A study a few years ago showed that 14 board feet of lumber and sawed timbers and 4 board feet of round mine timbers were required for each ton of ore mined in the Butte district (*20*). To say it differently, the average annual growth of 1 acre of forest was required to produce 5 tons of

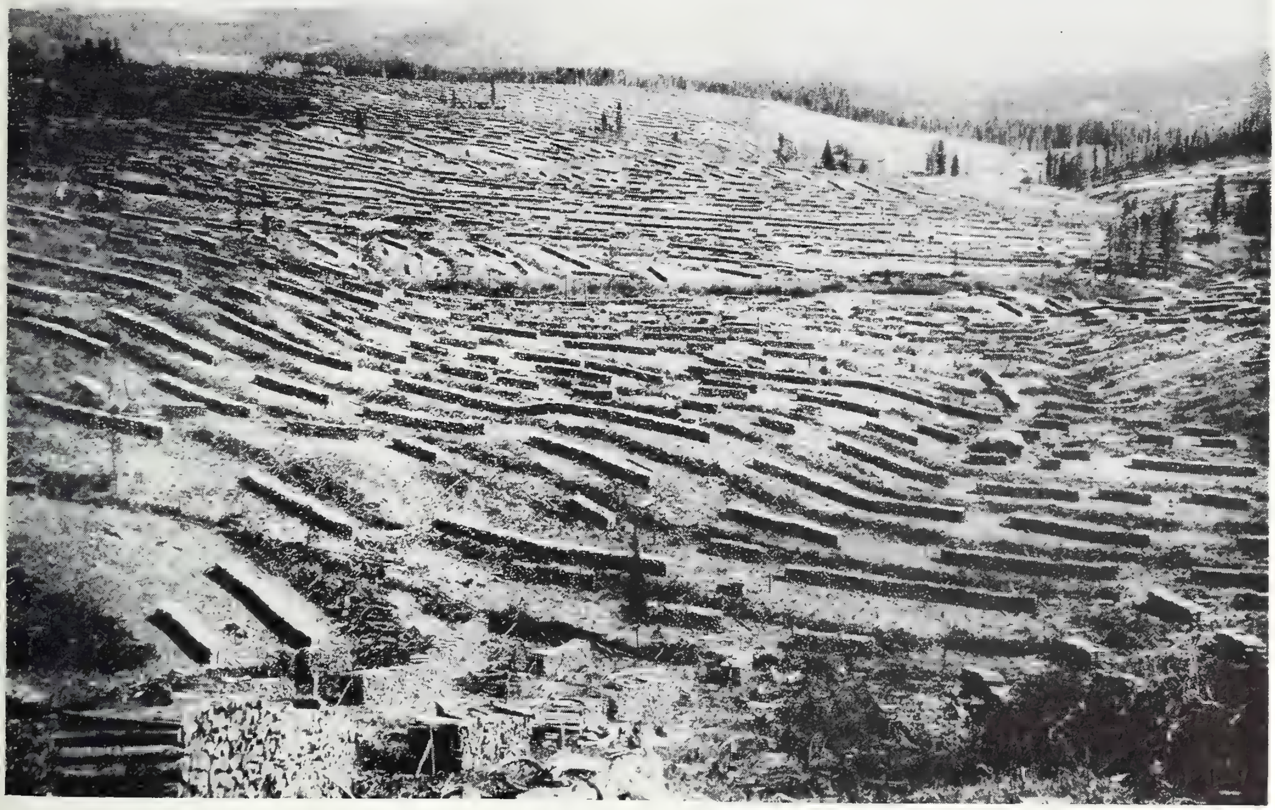

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Figure 3.—*This old picture was taken some time between 1884 and 1892 on the Deerlodge National Forest. Stacked on these rolling hillsides are row upon row of fuel wood destined for the smelter at Anaconda.*

metal ore. Shaft coal mines in eastern Montana likewise used considerable wood. For each ton of coal taken from Montana's shaft mines 0.92 linear foot of round timber and 0.23 board foot of lumber were consumed. Each year the entire mining industry in Montana used 43 million board feet of sawed material and 3 million cubic feet of round and hewed products (*20*).

Montana farmers are also heavy consumers of wood. It is estimated that they use about 6 million fence posts annually. The average western Montana farmer uses 1,700 board feet of lumber, shingles, and building logs annually as compared to about 1,100 board feet in eastern Montana. West of the Continental Divide, where timber is abundant and coal is scarce, many homes are heated with wood. The average wood-burning home in that area consumes about 13 cords a year.

Water Values in the Forest

It has been said that the greatest treasure of the West is water. While such enthusiastic statements tend to overlook the fact that the usefulness of water is almost wholly in servicing the land and its products, it is nevertheless true that continuous availability of usuable water is a key factor in the future development and prosperity of the region. A national news magazine (*1*) summed up the situation well when it pointed out "In the West, water resources are to determine which regions can grow, which will be held back. Water dictates the location of new industries, such as atomic installations, chemical works, steel and aluminum plants." Water to drink, water for power, water for irrigation, water for navigation, and so on—there is hardly a facet of living in this region that does not depend upon water.

In the past two decades we have had amazing evidence of what harnessing water power can start in the way of industrial development. At one time it appeared to some that the region might be headed toward power surpluses. Yet, industries are using all of the available electricity and are asking for more. Today it is apparent that, though the four Northwestern States use twice as much electricity per capita as the rest of the Nation, much of their hope for the future rests upon new hydroelectric developments. The streams of Montana can support hydroelectric plants with a capacity of some 4,070,000 kilowatts which is more than 11 times the capacity of existing water power plants. Moreover, this potential is equal to one-fourth of all the developed hydroelectric power capacity in the United States today.

In this semiarid region water for irrigation adds a great deal to agricultural income and stability. In the absence of irrigation, many areas with fertile soils are of low productivity. Irrigated lands produce from 80 to 100 percent of the cultivated and hay crop values in many sections of the 11 Western States. Figure 4 shows the proportion of crop income of Montana counties from irrigated lands in 1939.

Roughly 1.8 million acres in Montana are irrigated. Four-fifths of that acreage is in the Missouri River basin. According to an estimate by the National Resources Board in 1936, the total area which could ultimately be irrigated in Montana is 3.9 million acres. Only California, Colorado, and Wyoming have greater potentialities for irrigation from the standpoint of area. Between 1929 and 1947 an average of 23 percent of the total cultivated and hay-land area in Montana was irrigated and produced about 33 percent of total crop value (*8*).

The importance of irrigation is more than one of comparative yields. In the Great Plains part of Montana, dry-land farming involves gambling on the weather. Some areas have received as little as 5 inches of precipitation a year. The frequency of such years when the snow and rainfall are too light for good dry-land crops is the Achilles' heel of Montana's agriculture. During one drought year (1936) 63 percent of the crop value was pro-

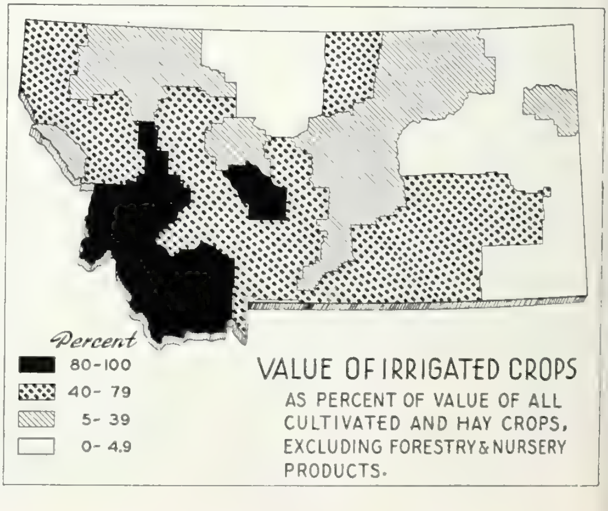
Percent
■ 80-100
▩ 40- 79
▨ 5- 39
☐ 0- 4.9
VALUE OF IRRIGATED CROPS
AS PERCENT OF VALUE OF ALL CULTIVATED AND HAY CROPS, EXCLUDING FORESTRY & NURSERY PRODUCTS.

Figure 4.

duced on irrigated land. Expansion of the irrigated acreage is regarded, therefore, as a means for obtaining a greater stability for Montana's agriculture (fig. 5).

The great value of water makes it the most important of all the products of Montana's forest land. Annual precipitation on forest land is probably three times as great as it is on nonforest land, and the difference in precipitation on the higher mountain areas and dryer lowland areas is much greater even than that. Though only one-fourth of Montana is covered with tree growth, seven-tenths of the runoff or stream flow originates on timbered areas (fig. 6).

When we take into account the factor of usability, i. e., timeliness, quantity, and quality, water from the forest assumes even greater importance. In general the daily, monthly, and yearly runoff from forest land is much more stable than from nonforest land. Winter snows of low-lying areas melt quickly with the first spring thaws and run off in quantities larger than can be used. A later and more gradual runoff comes from the forested, higher elevations. Consequently, during the late summer when water is at a premium, 80 to 90 percent of the stream flow comes from forest land.

In land management for water production the objective is to secure water flows that meet the requirements of timeliness, quantity, and quality. Forests exert an important influence on what happens to the precipitation even though they may not affect the amount of precipitation. This influence may be good or bad, depending upon the character of the forest management. Therefore, people in the Missouri River and Columbia River basins, and even as far away as Astoria, Oreg., and New Orleans, have by virtue of their dependence upon water a deep-seated interest in how the forests of Montana are handled.

Recreation Values of the Forest

Recreation enters into this report on Montana's resources because a large part of the State's attraction is in its beautiful forest country (fig. 7). To most Americans the term "Montana" means rugged mountains and wide open spaces. Those who come to the State for vacations seek mainly to enjoy an invigorating summer climate, fine mountain scenery, lovely lakes, rushing streams, an abundance of fish and game, and some of the last real wilderness in the United States.

Extending into Montana on the south is Yellowstone National Park, the oldest and one of the most visited of all our public parks. Lying entirely within Montana is Glacier National Park. It was established in 1910 because of its outstanding scenic attractions. Approximately 296,000 people visited Glacier Park one or more times in 1949. A survey of visitors staying overnight in the park indicated that on the average they spent 9 days in Montana (*4*). Particularly significant is the fact that 75 percent of the visitors interviewed said that they had come to Montana primarily to see the park.

In addition to the national parks the Federal Government has dedicated 1.6 million acres of national-forest land in Montana as Wilderness and Wild Areas. These areas are primarily of value for recreation and are to be left in their natural wild state except for developments needed for fire protection. Thus, the public has seen fit to set aside one-tenth of all the forest land in Montana[5] to preserve certain scenic and wild attractions.

The countless fishing streams throughout Montana's forests and an abundance of wildlife are a major recreational attraction (fig. 8). A 1948 inventory (*18*) shows that Montana had 236,600 big game animals distributed as follows: mule deer, 109,800; white-tailed deer, 40,500; prong-horned antelope, 35,300; elk, 35,000; black bear, 6,700; mountain goat, 4,100; moose, 3,100; rocky mountain bighorn, 1,400; grizzly bear, 691; and woodland caribou, 15. Data from the Fish and Wildlife Service indicate that in 1949 Montana was second only to Idaho in number of hunting and fishing licenses and duck stamps purchased per capita.

From a strictly materialistic view, it can be pointed out that recreation is a big, profitable business in which Montana has a share. Recreation visitors have added greatly to the income of this State in the past and they can bring in many more dollars in the future.

Just how much income recreation brings into Montana no one knows. However, State Highway Department estimates show that the spending by out-of-State auto tourists alone amounts to a very substantial sum (fig. 9). During 1949 they spent $65,000,000. While Montana is often called the copper State, the tourists' spending was three times the value of the copper mined that year.

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[5] Actually, more than half of this area is unsuited for timber production.

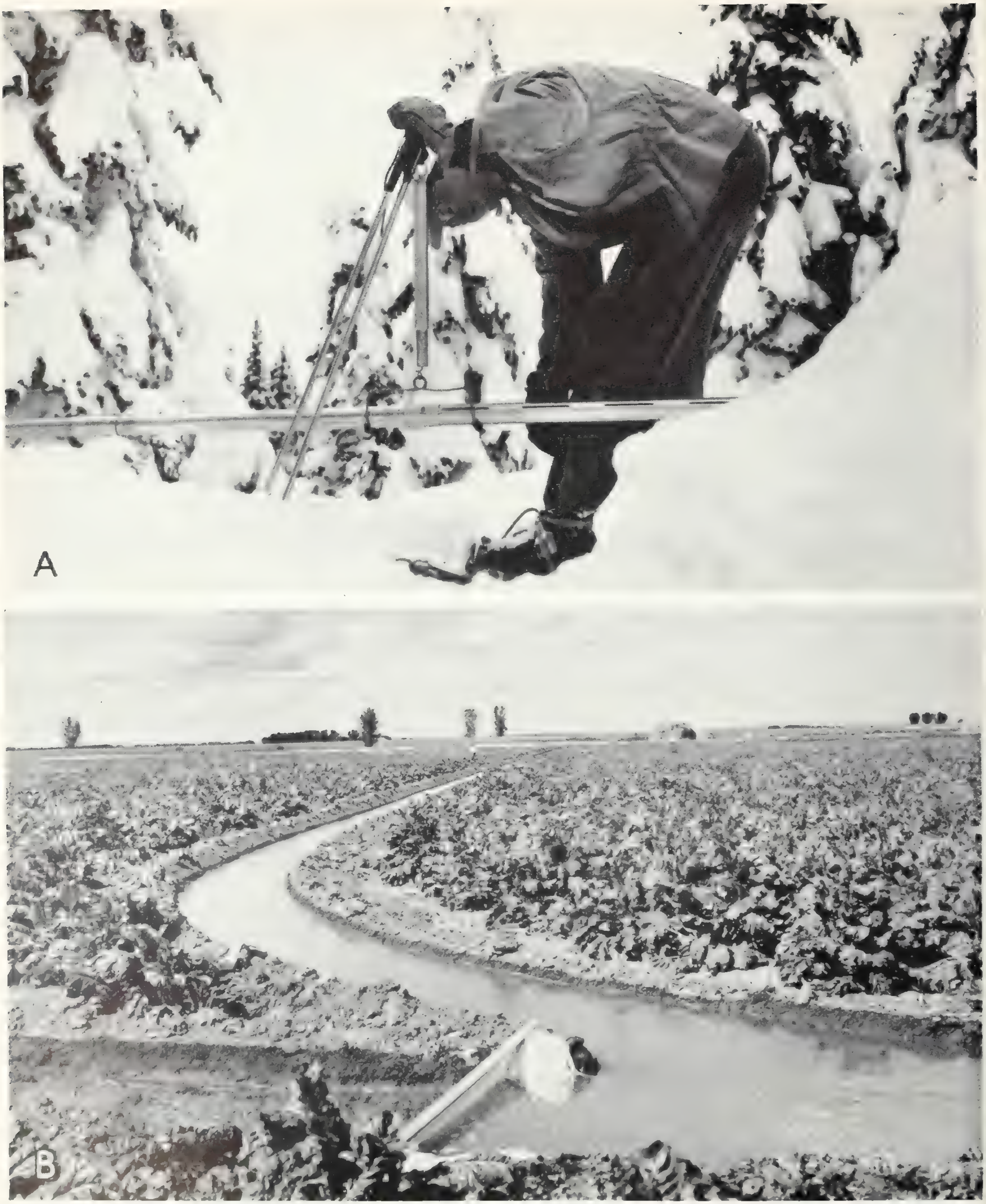
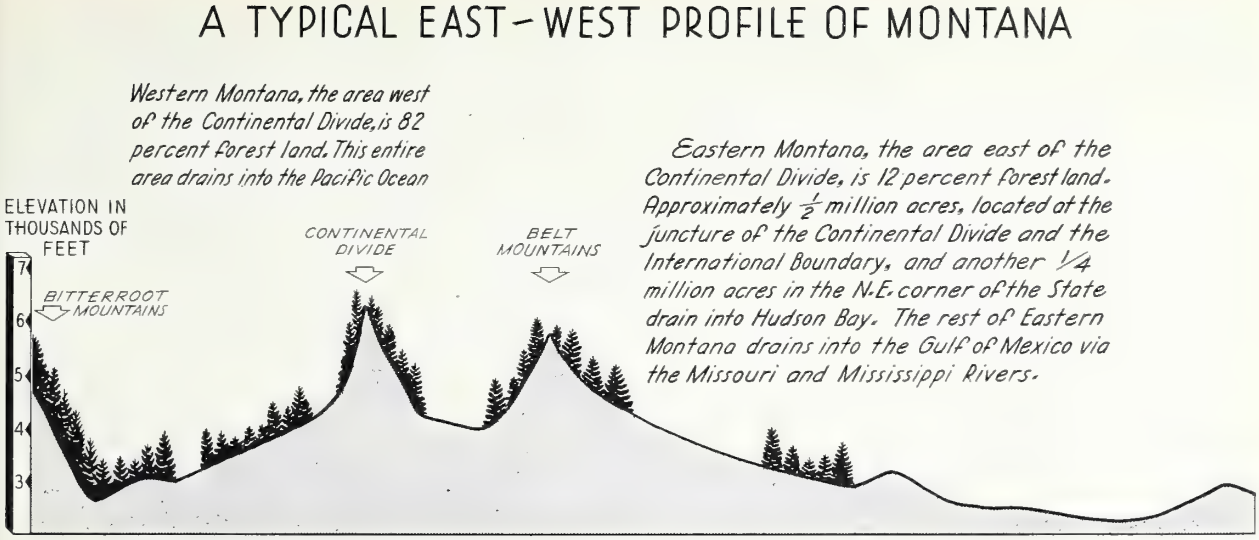


Figure 5.—*Water for sugar beets and other farm crops. A, a member of a survey crew measures the depth and moisture content of snow; B, snow supplies the greater part of the water for irrigated land, such as this on the Yellowstone River. (Photo A, courtesy of Ross Hall Studio; B, Bureau of Reclamation.)*


A TYPICAL EAST-WEST PROFILE OF MONTANA
ELEVATION IN THOUSANDS OF FEET
7
6
5
4
3
BITTERROOT MOUNTAINS
CONTINENTAL DIVIDE
BELT MOUNTAINS

Western Montana, the area west of the Continental Divide, is 82 percent forest land. This entire area drains into the Pacific Ocean

Eastern Montana, the area east of the Continental Divide, is 12 percent forest land. Approximately $\frac{1}{2}$ million acres, located at the juncture of the Continental Divide and the International Boundary, and another $\frac{1}{4}$ million acres in the N.E. corner of the State drain into Hudson Bay. The rest of Eastern Montana drains into the Gulf of Mexico via the Missouri and Mississippi Rivers.

Figure 6.

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Figure 7.—*Blue Paradise Lake on the Gallatin National Forest. Such beautiful country as this is one of Montana's great assets. Here you will find the largest remaining wilderness.*

Forage Values in the Forest

One-third of Montana's forest land, or roughly 7.2 million acres, supports enough plants of forage value to classify it as suitable for grazing. The distribution of this forest-grazing land by ownership class, in million acres, is estimated as follows: private, 2.0; State and county, 0.7; national forest, 4.0; other Federal, 0.5.

FIGURE 8.—*One of the many wild animals which abound in Montana's forest. Montana is the principal home of this cub's ferocious cousin, the grizzly. Eighty-five percent of all the grizzlies in the United States today roam in Montana. (Photo courtesy of State of Mont. Dept. of Fish and Game.)*

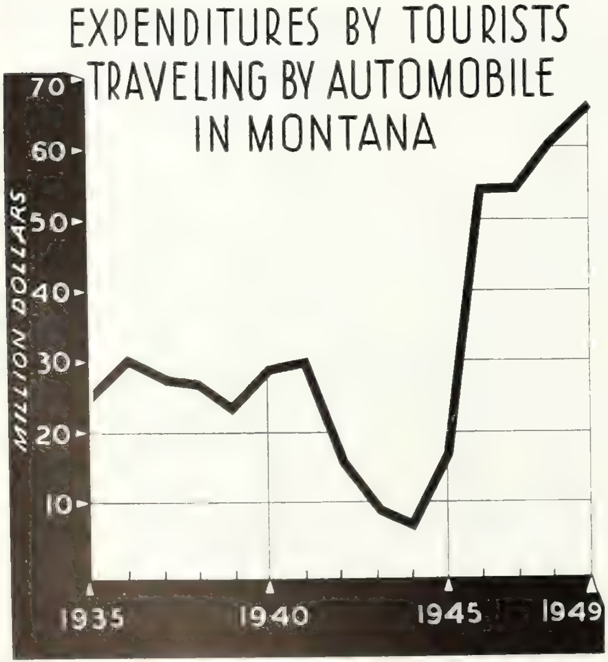

FIGURE 9. Source: Montana State Highway Dept.

Several hundred thousand cattle, horses, and sheep graze on forest land for a part of each year. Although the 7.2 million acres include some poor range land, they also include some of the best. The succulent forage on many open-forest areas at the higher elevations provides exceptionally fine grazing (fig. 10); a majority of the lambs coming off such areas go directly to packing plants without further fattening.

The forest and intermingled open range is also the home of most of the big game which makes Montana a hunter's paradise. Winter range areas on and adjacent to the national forests, used by the principal big game animals, are 2,923,000 acres, elk; 6,490,000 acres, mule deer; and 1,918,000 acres, white-tailed deer. These acreages overlap for the simple reason that the habitats of the animals overlap to some extent.

Timber Can Increase Montana Income

Montana's economy rests mainly upon its farms, mines, and forests which provide a considerably larger portion of the State income than they do of the national income. Montana's dependence upon farming is particularly great. In 1948, for example, 34 percent of the State income was from agriculture in contrast with 10 percent for the United States.

It is generally agreed that the principal trouble with Montana's economy is that it is not sufficiently diversified. Too many of its eggs are in one basket, so to speak—the farm basket. Certainly it is true that when Montana agriculture has ridden high Montana has ridden high and when the farmer's income has slumped, the State has gone down with it. Another indication of the lack of balance in the economy of the State is the smallness of the manufacturing output (fig. 11). According to Department of Commerce figures for 1948, only 6 percent of the State income as against 22 percent of the total United States income is from manufacturing.

Against this background Montana's timber supply becomes especially important. This timber not only offers the opportunity for increasing Montana's income, but also for expanding manufacturing and broadening the economic base.

In some ways, the timber-supply situation in

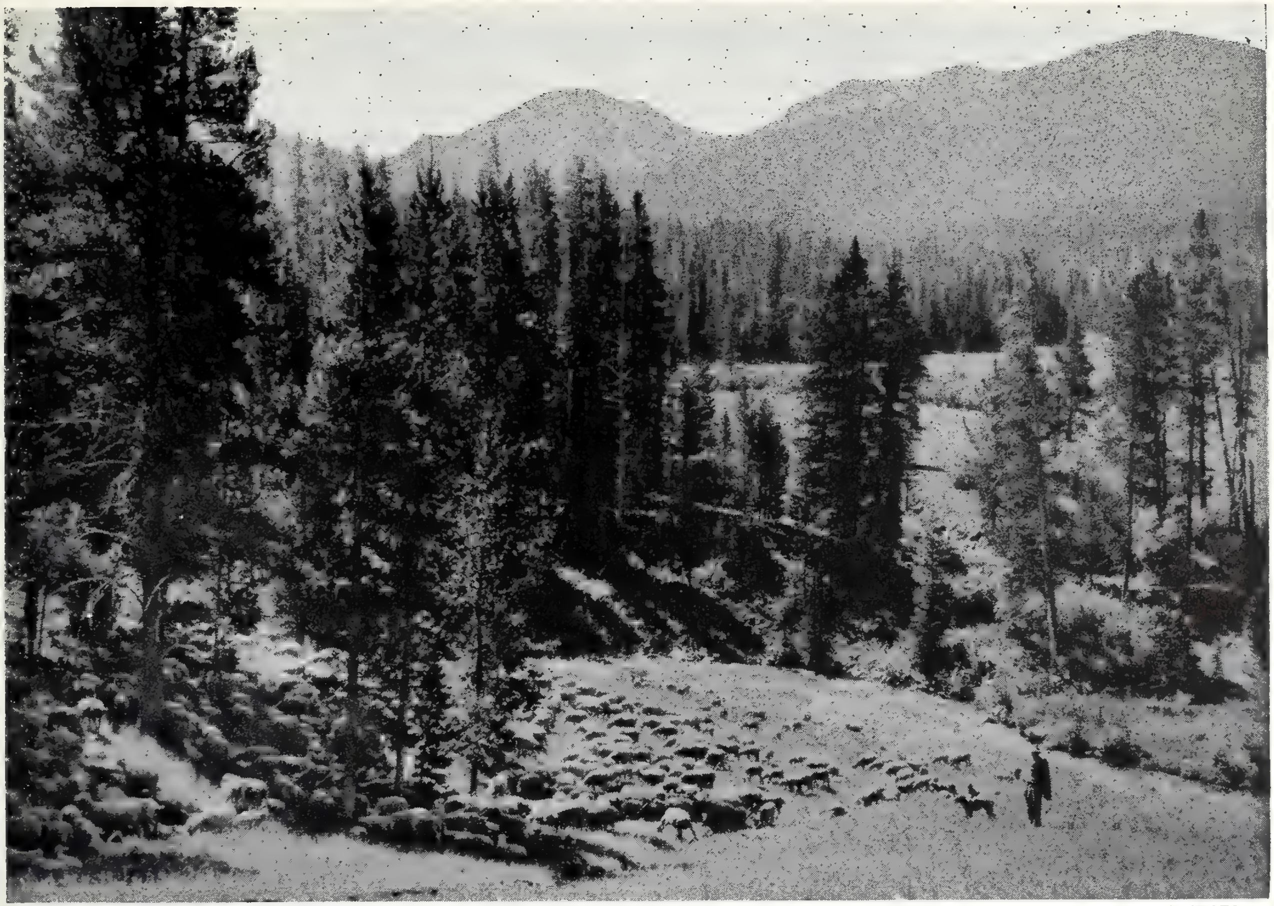

Figure 10.—*Sheep on their way to summer range in the high mountains of the Gallatin National Forest. During 1948 there were 117,000 cattle and horses and 273,000 sheep under paid permit on the national forests of Montana.*

Montana is very good; there is a great backlog of saw timber. For the Nation as a whole, the problem is one of impending shortages, and in the eastern half of the United States, the saw-timber stand is about half as large as is necessary to meet the long-range timber requirements estimated by the Forest Service. The situation in Montana is in pleasing contrast with this. Full use is not being made of the capacity of the forests to produce wood. There is sufficient timber available in the State to permit a permanent expansion of some types of industrial use.

Even though the over-all situation is encouraging, some problems remain. There has been excessive development in spots and underdevelopment in others. The reason for that lies in the transportation problem. Before the first wood-burning steam engine chugged in from Ogden in 1880, Montana was part of the remote West, so remote as to preclude the export of any but the most valuable products. The construction of four transcontinental railways into the State brought it closer to the East. Even so, Montana is still handicapped by transportation difficulties.

The cost of getting products to the principal markets of the United States has placed a heavy share of the load on resources that can pay the freight. Ponderosa and white pine, because of their high value, have been so heavily cut that there is a shortage problem. Some mills have shut down in past years for the lack of these species, even though there was ample timber of other species available which was of good quality and suitable for many purposes.

Since World War II a high demand for timber products has improved the position of Montana's secondary species. The problem of lack of markets is, however, a long way from being fully overcome; there are still large volumes of unmarketable timber. Part of the answer to this predicament lies in increasing the industrial appetite for woods other than ponderosa and white pine.

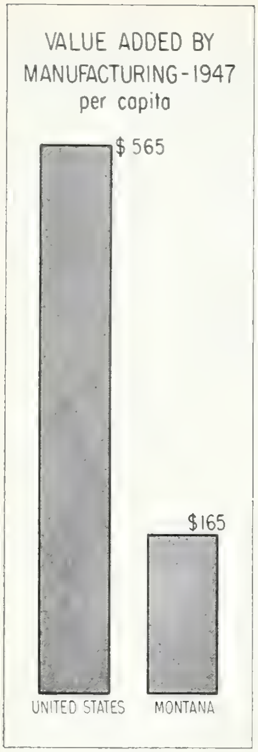

FIGURE 11.

Inability to get at timber that should be logged has been a major handicap to forest development. Many stands are effectively locked up by the absence of roads over which to move the timber. During the past half century many miles of road have been built, but they are hardly more than the minimum required to protect the timber from fire. A large part of the logging has been on the fringes of the forest. If the forest is to sustain the maximum of industrial development, it must be made accessible enough to permit a desirable degree of utilization and management (fig. 12).

A large volume of mature and overmature timber presents a difficult management problem. Cutting must be spread over a long period while young stands are being grown (fig. 13), and there is a constant temptation to cut too heavily. Such timber is particularly vulnerable to attacks by insects and disease. In fact, in the past 50 years there has been a stupendous loss from insect attacks and the problem has not been coped with adequately.

Any consideration of the big job of handling Montana's forest to produce continuing high yields of timber sooner or later brings up the matter of ownership and the job of management being done. Both private and public owners have satisfactory records in holding down fire losses in a highly flammable forest. However, adequate forest management means more than that. It means careful conversion of an overmature forest to a young growing forest, accelerating the growth rate, and utilizing large volumes of timber now being wasted.

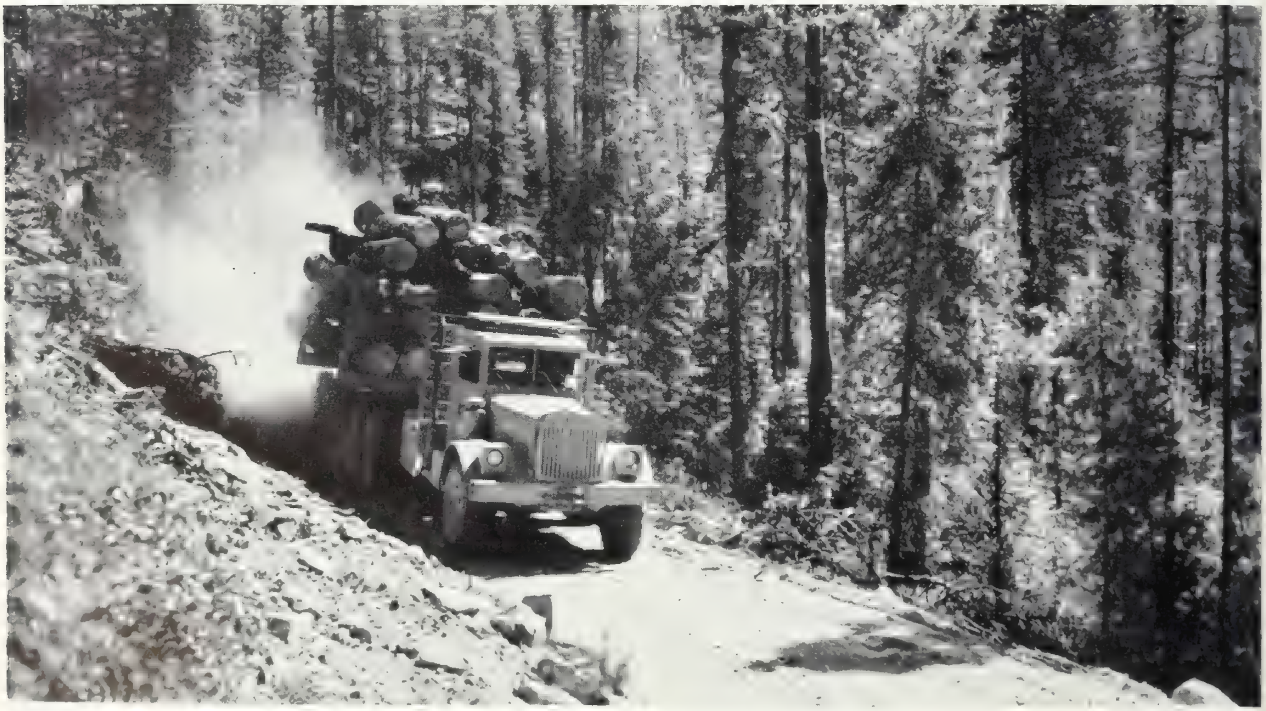

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FIGURE 12.—*Hauling timber over a timber access road on the Kootenai National Forest. Montana has a timber-growing capacity that has not been utilized to the extent possible and desirable. Greater utilization requires, among other things, road construction to make the timber available.*

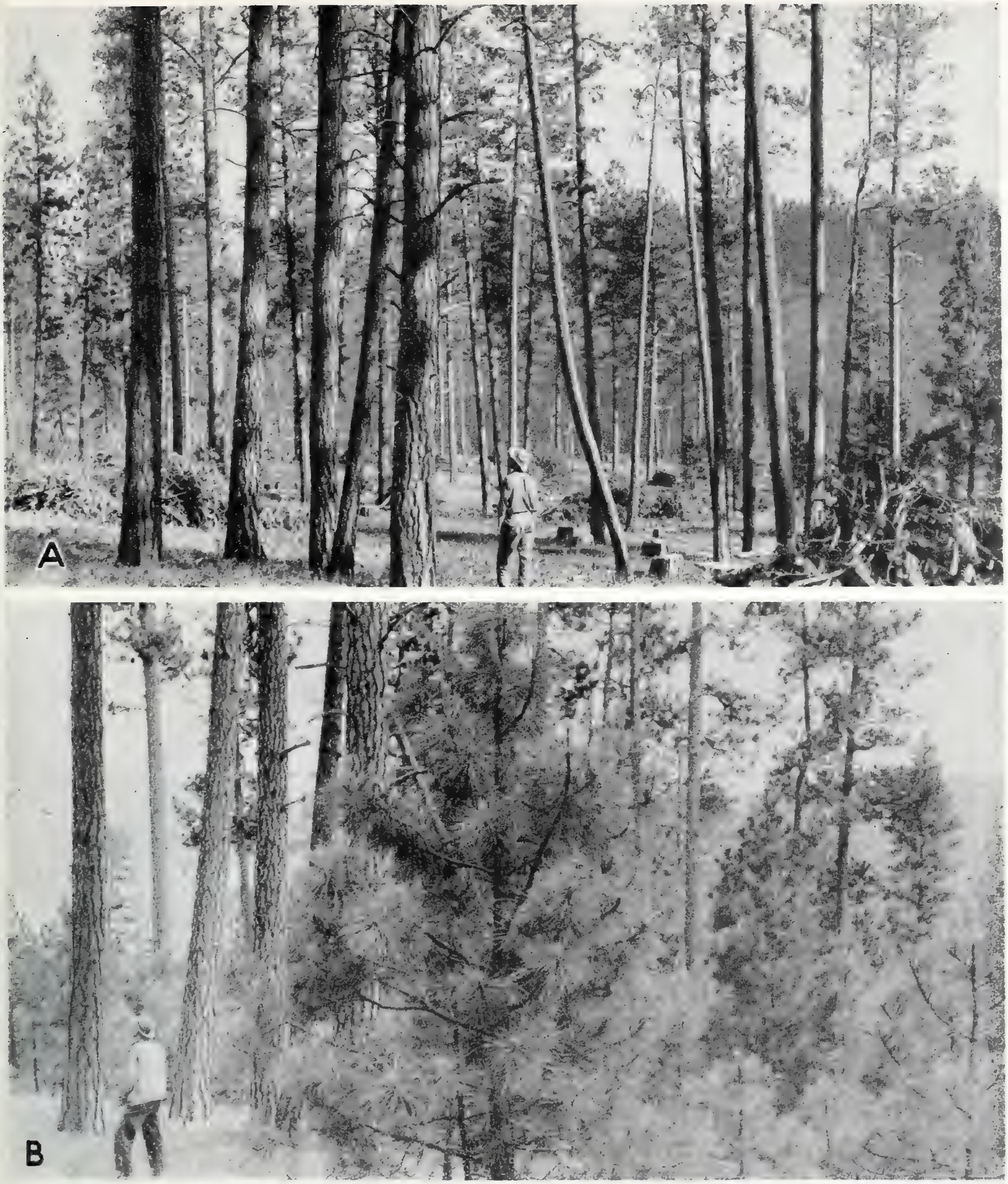

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Figure 13.—*A, The Lick Creek timber sale on the Bitterroot National Forest in 1909 shortly after logging. B, The same area 39 years later. The Lick Creek sale is notable as the first large-scale selective cutting operation in Montana. It was one of the early attempts to cope with the difficult silvicultural problems found in a forest with a high proportion of overmature timber.*

The Forest

ONE-FOURTH of Montana is forest land,[6] 22,359,000 acres in all. This is about 3½ percent of the total forest in the United States. Only five other States have a larger forest area. Thirteen million acres of Montana's forest lie west of the Continental Divide, and 9 million acres are in eastern Montana. Distribution within the two areas, by class of land, is as follows:

Class of forest land:	*Western Montana (million acres)*	*Eastern Montana (million acres)*	*Total (million acres)*
Commercial	8.9	6.9	15.8
Noncommercial	2.5	1.6	4.1
Reserved	1.6	.9	2.5
Total	13.0	9.4	22.4

Montana's forest is neither homogeneous nor evenly distributed. For convenience, its distribution can be described this way: Where there are mountains there is forest. The mountain ranges are mainly in the western two-fifths of the State and extend in a general northwest-southeast direction, turning eastward along the southern border of the State. Where there are extensive low areas or prairies, the natural vegetation generally is grass and sagebrush, except for thin stringers of timber along the rivers and streams.

West of the Divide, particularly in the northwest corner of the State, the rough topography sets up conditions that result in more moisture than occurs farther east. Because of this favorable climatic factor, the forests of western Montana cloak 81 percent of the total land area and extend over all but the wider valley floors.

East of the Divide the drier climate holds the lower margin of the forest higher on the mountain slopes, in some localities 6,000 feet and more above sea level. Consequently, most of the timber in eastern Montana occurs as a series of islands or patches. Figure 14 shows the proportion of forest area to the total land area in various parts of the State.

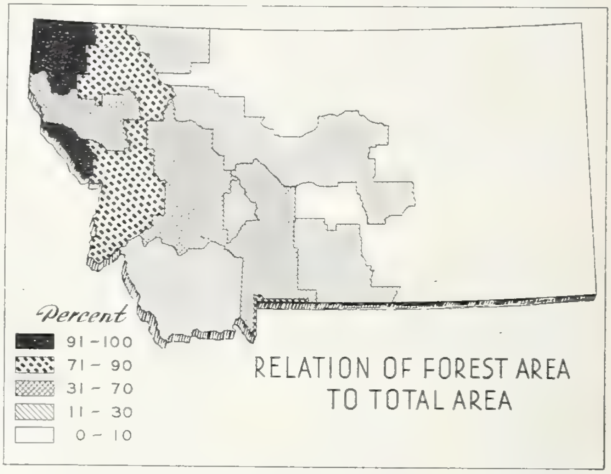

FIGURE 14.

Moisture and temperature also have much to do with the great variation of timber types within the forest. These two weather factors are in turn related to altitude and exposure. There is an 11,000-foot difference between the highest and lowest points in Montana.

The Reserved Forest

One-tenth of the Montana forest (2.5 million acres) is reserved and thus unavailable for timber use. Most of the reserved area is federally owned land in Glacier and Yellowstone National Parks (933,000 acres) and wild and wilderness areas in the national forests (1,588,000 acres). Figure 15 shows the location of these principal reservations. Approximately half of the reserved area (1,070,000

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[6] The definition of "forest land" and other Forest Survey terms used in this report are in the appendix, pp. 60 to 62. Because the terminology differs somewhat from that in earlier reports, the definitions should be studied carefully.

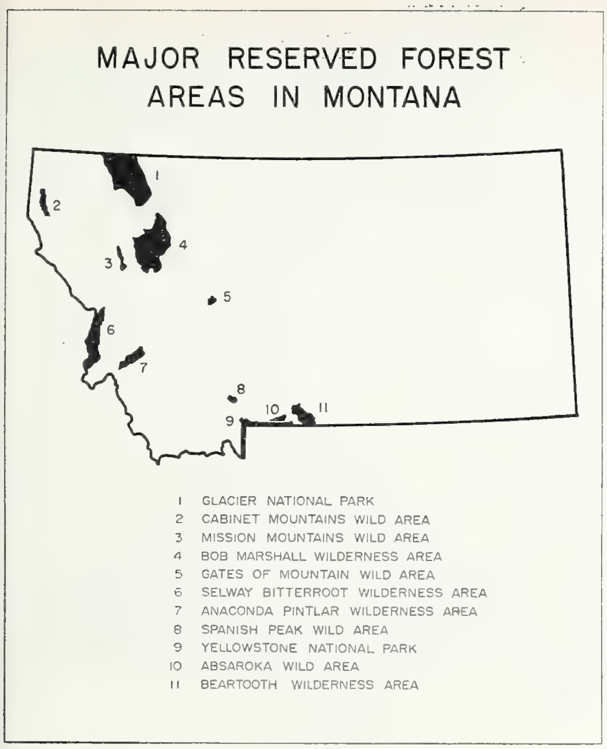

MAJOR RESERVED FOREST AREAS IN MONTANA
1
2
3
4
5
6
7
8
9
10
11
1 GLACIER NATIONAL PARK
2 CABINET MOUNTAINS WILD AREA
3 MISSION MOUNTAINS WILD AREA
4 BOB MARSHALL WILDERNESS AREA
5 GATES OF MOUNTAIN WILD AREA
6 SELWAY BITTERROOT WILDERNESS AREA
7 ANACONDA PINTLAR WILDERNESS AREA
8 SPANISH PEAK WILD AREA
9 YELLOWSTONE NATIONAL PARK
10 ABSAROKA WILD AREA
11 BEARTOOTH WILDERNESS AREA

Figure 15.

acres) would, if it were not reserved, be classed as commercial because it is potentially accessible and has the capacity to produce usable timber.

The Noncommercial Forest

In addition to the reserved area, 4.1 million acres cannot be considered from an industrial standpoint. These 4.1 million acres, though available for timber growing, either lack the capacity to produce usable timber or are too remote or inaccessible for the most part to ever be logged. Although this noncommercial forest is widely scattered, by far the larger part occurs at the climatic upper limits of the forest zone where drying winds, a general harshness of weather, and a thin soil mantle retard tree growth. Alpine fir, whitebark pine, and Engelmann spruce predominate. Figure 16 shows a typical high-altitude noncommercial stand.

Along the dry lower margin of the forest in eastern Montana, where the timber gives way to grass, there is another belt of scrubby timber. Because wood is generally at a premium in such localities, most of these stands are logged to some extent and by such use become "commercial." However, some of the poorer quality juniper stands are classed as noncommercial. Throughout the commercial forest there are patches of very steep or very rocky land which are unsuitable for timber production and, therefore, classed as "rocky noncommercial." A typical rocky noncommercial area is shown in figure 16.

Noncommercial forest lands by definition are of negligible importance from the standpoint of producing usable timber. However, since more and more attention is being given to water development and control in the Columbia and Missouri River Basins, the importance of these lands from a watershed standpoint is increasingly evident. The deep snowfall in Montana is on the higher areas where such forest predominates. Trees on these areas have much to do with the rate of snow melt and runoff. Thus, though the noncommercial forest lacks the capacity to grow usable wood, it will receive more attention from forest managers in years to come.

The Commercial Forest

More than two-thirds of the forest area in Montana is both suitable and available for timber production. This area, 15.8 million acres in all, is therefore classed as commercial. Fifty-six percent of the commercial forest in Montana lies west of the Continental Divide.

The Forest Survey recognizes the 8 general commercial forest-type groups shown below. Several of the groups are divided into subtypes, as shown in the appendix tables.

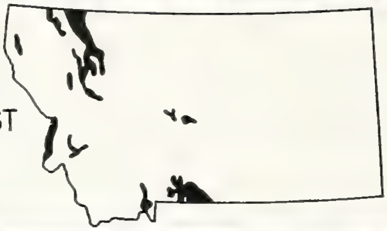
Forest type group:	*Western Montana (million acres)*	*Eastern Montana (million acres)*	*Total (million acres)*
White pine	0.3	..	0.3
Ponderosa pine	2.2	1.2	3.4
Larch	2.6	..	2.6
Douglas-fir	1.2	1.7	2.9
Spruce-fir	.4	.3	.7
Lodgepole pine	2.2	2.5	4.7
Hardwoods	..	.4	.4
Coniferous woodland	..	.8	.8
Total	8.9	6.9	15.8

Four types (lodgepole pine, ponderosa pine, Douglas-fir, and larch) cover 86 percent of the commercial forest.

A considerable forest area at the lower elevations in eastern Montana bears scrubby, low-quality stands. Some of the area is noncommercial but most of it (800,000 acres) is classed as commercial and

⇧ SUBALPINE NONCOMMERCIAL

MAJOR OCCURRENCE OF NONCOMMERCIAL FOREST



⇩ ROCKY NONCOMMERCIAL

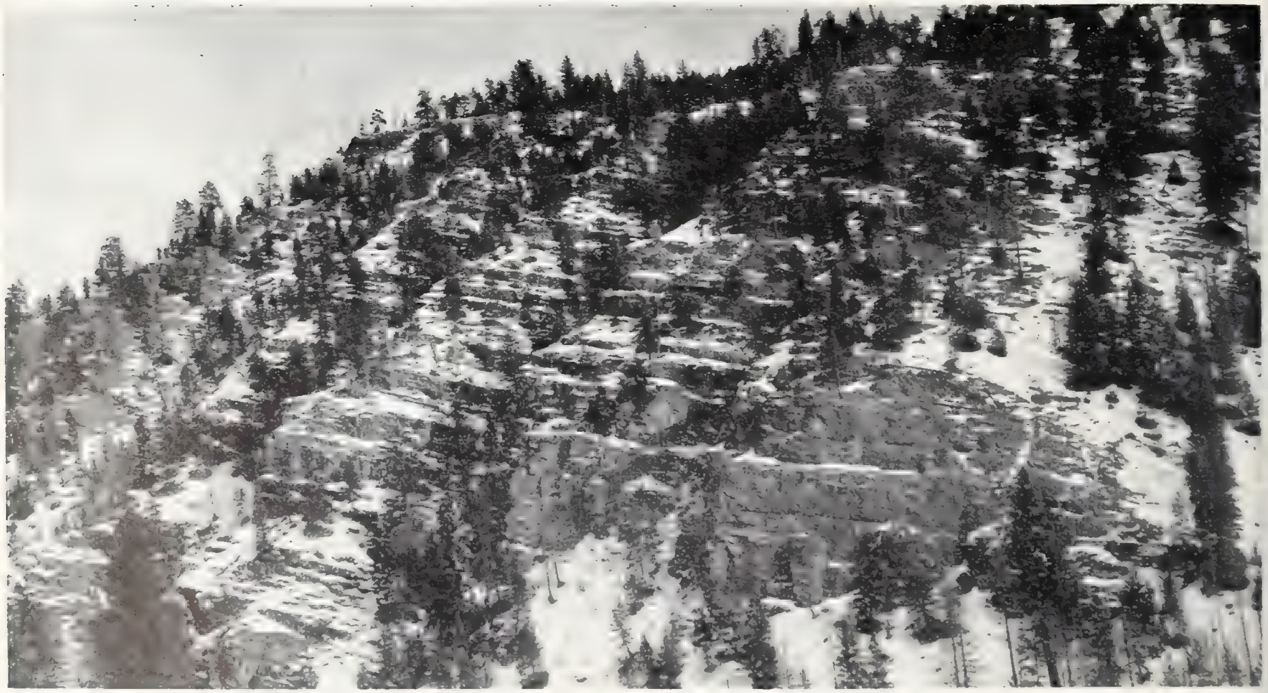


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Figure 16.—*Subalpine and rocky noncommercial stands.*

included as "coniferous woodland" type. This coniferous woodland can best be described as scrubby open stands along the outer margin of the forest, with only limited usefulness from a timber-supply standpoint. Several species are found in the woodland type, but 75 percent or more of the area is dominated by ponderosa pine and juniper.

Montana's saw-timber supply totals 56 billion board feet,[7] which is 3½ percent of the saw-timber stand in the entire United States. This figure, the first based on a complete field survey, is somewhat higher than earlier estimates. In 1925 the saw-timber stand was estimated to be 50 billion board feet (*2*), and in 1945, prior to completion of the Forest Survey in eastern Montana, the estimate was raised to 53 billion.[8] Because the earlier estimates were based on far fewer measurements than the present one and are subject to unknown errors, it cannot be assumed that the differences between estimates indicate actual trends. Also, the standards in the present survey are different from those formerly used. This matter is more fully discussed in the appendix, p. 60.

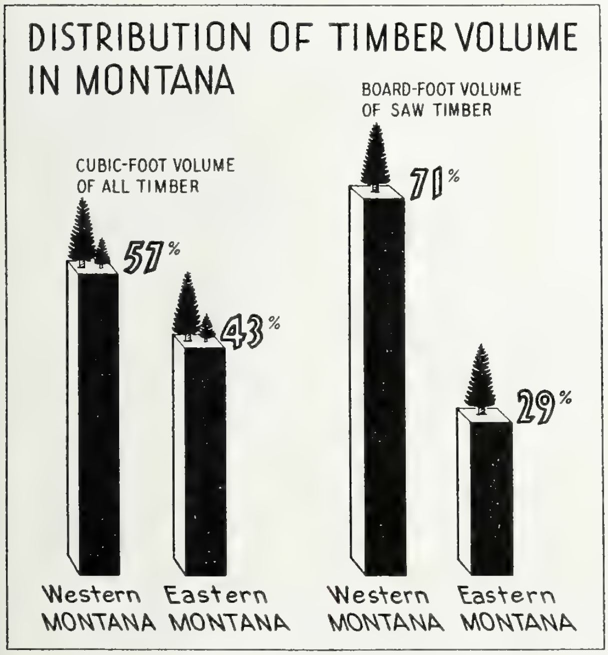

Figure 17.

Figure 17 shows the geographic distribution of timber volume. Although 71 percent of the saw-timber volume in the State is located west of the Continental Divide only 45 percent of the total volume of pole timber is in that part of the State. The low saw-timber volume in eastern Montana (29 percent) is accounted for by the fact that much of the timber there is lodgepole pine, a large part of which never grows big enough to be classed as saw timber.

Douglas-fir is the most common tree in Montana, and lodgepole pine is a close second. Other principal species are western larch, ponderosa pine, and spruce. As shown in the following tabulation, more than half of the total live, sound timber in the State is Douglas-fir and lodgepole pine.

Species:	*All timber (billion cubic feet)*	*Saw timber (billion board feet)*
Douglas-fir	4.7	15.4
Lodgepole pine	4.1	6.9
Western larch	2.4	11.8
Ponderosa pine	2.2	11.0
Spruce	1.4	7.0
Grand fir, hemlock, redcedar	.3	.9
Whitebark and limber pine	.3	.6
Alpine fir	.3	.6
Hardwoods	.3	.7
Western white pine	.2	1.1
Total	16.2	56.0

Ponderosa Pine

The 11 billion board feet of ponderosa pine in Montana is about 6 percent of the total saw-timber volume of this species in the United States. Eighty-five percent of the Montana ponderosa pine is west of the Continental Divide.

Ponderosa pine, which grows throughout the West, is one of the most important woods in the United States. Its superior workability makes it much in demand, a fact that has given it a strong market position in comparison with some of the other Montana conifers. These factors make ponderosa pine one of the major timber assets in this State.

Commercial forests in which ponderosa pine is the key species are of two general classes: the more or less scrubby and open woodland type stand already discussed, and the denser ponderosa pine type of which there is 3.4 million acres in Montana (fig. 18).

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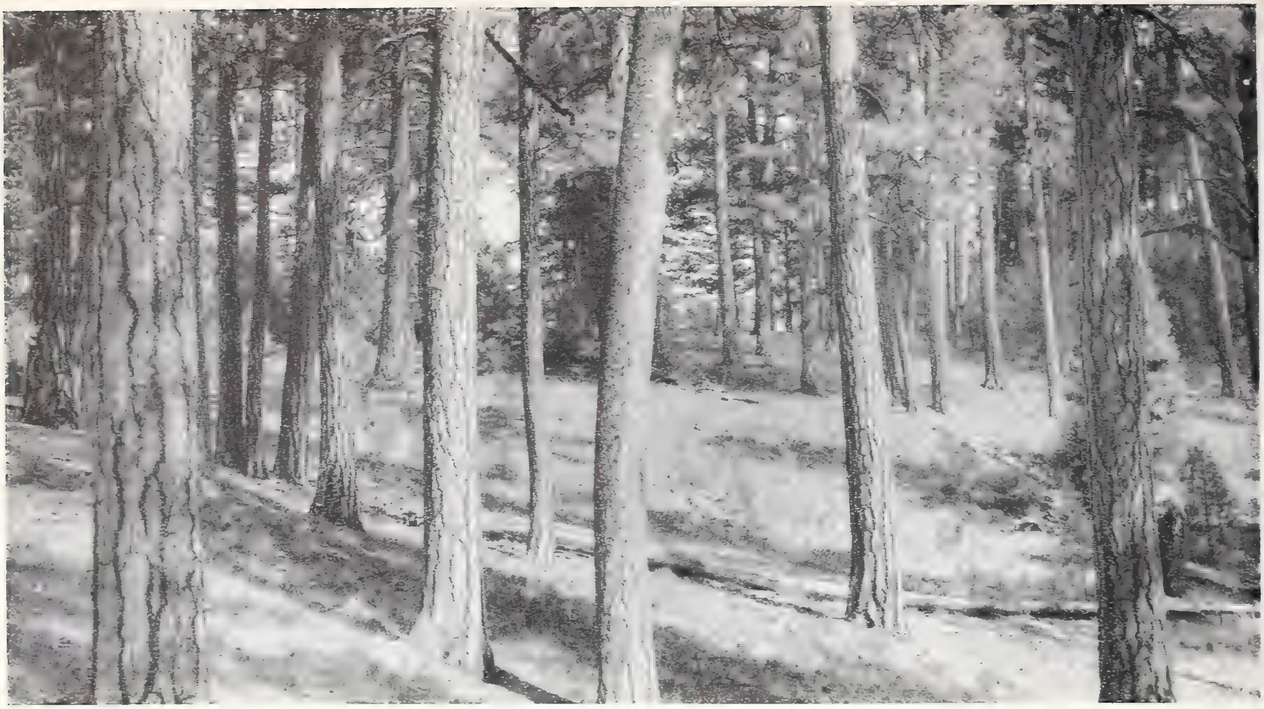
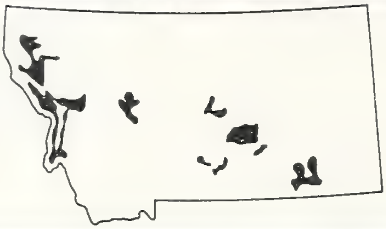
[7] Board-foot volume figures in this report include only the sound wood in the sawlog portion of noncull trees 11.0 inches in diameter and larger.

[8] Forest Service basic statistics for U. S. Dept. Agr. Misc. Pub. 668, Forests and National Prosperity—A Reappraisal of the Forest Situation in the United States. 1948.





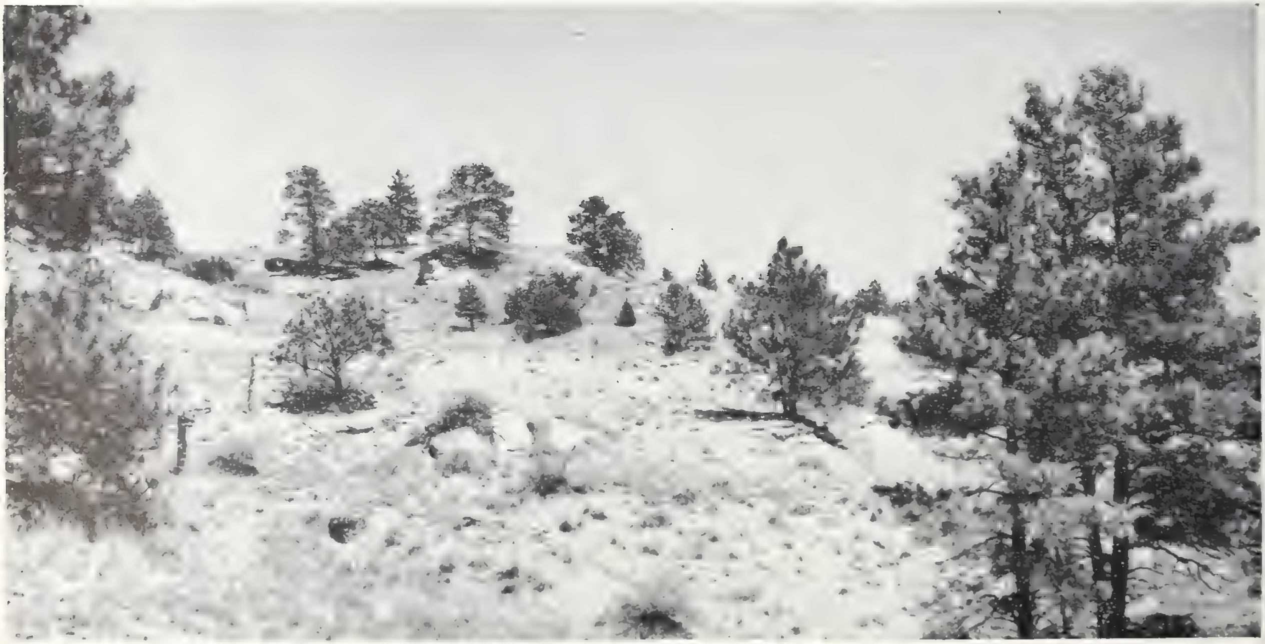


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FIGURE 18.—*Ponderosa pine forest.*

The ponderosa pine areas of eastern Montana are, with a few exceptions, of low quality from the standpoint of producing capacity. In western Montana the stands are better and the average site quality is classified as "medium." This is about the same as in the pine region of eastern Oregon and Washington.

The ponderosa pine type in western Montana can be subdivided into the pure stands found on the drier areas, and the mixed type in which the pine occurs along with other species, principally Douglas-fir. Ecologically speaking, the mixed pine forest is growing on Douglas-fir sites and the presence of ponderosa pine is accounted for largely by past fires. The improved fire protection of recent years and the logging of the pine create a management problem of how to keep Douglas-fir from gradually taking over most of these areas.

Douglas-fir

Montana has 15.4 billion board feet of Douglas-fir. Though it is the most common species in the State, only 3½ percent of the total saw-timber supply of Douglas-fir in the United States is located in Montana.

Few, if any other important American trees, grow under more diverse climatic conditions than Douglas-fir. The range of this species stretches all the way from the humid Pacific slope of Washington and Oregon to the semiarid parts of eastern Montana. The tree itself varies as much as the climatic conditions of its range. On the Pacific coast occasional trees have reached diameters in excess of 10 feet. In Montana a 36-inch Douglas-fir tree is a large one and the average saw-timber tree of this species is about 16 inches in diameter. Sixty-three percent of the Douglas-fir saw-timber volume is in 11- to 20-inch trees and 33 percent in 21- to 30-inch trees.

Even though the Montana Douglas-fir is considerably smaller and more scrubby than the coast variety, it is locally important. In eastern Montana, where it is used for bridge planking and other structural purposes, Douglas-fir is probably more sought after than ponderosa pine. It is particularly suitable for timbering the metal mines of western Montana, because it gives warning signs of structural failure.

Douglas-fir is the main species on 2.9 million acres of commercial forest land (not including woodland), six-tenths of which is in eastern Montana (fig. 19).

Western Larch

Forty-four percent of the western larch saw timber in the United States is in Montana—a total of 11.8 billion board feet. All of the larch except for a few trees occurs west of the Continental Divide.

Larch is one of the larger and better trees in Montana, growing tall, straight and clear, and occasionally reaching a diameter of 5 feet. Its growth habits are such that it will produce more clear wood than any other native tree. Seventy-two percent of the volume in larch saw timber today is in trees 20 inches and larger.

Larch is believed by some to have more undeveloped potentialities than any other native species. It is used mainly for sawed lumber products, a purpose for which it has not commanded a high price and certainly not the one for which the higher quality trees are best suited. Tests prove it to be a very good veneer wood. This species is also unusually rich in galactose sugar, an extractive that makes up from 12 to 20 percent of the dry weight of the wood. The heaviest concentration of sugar is found at the butt of the tree. As yet no industrial use is made of this extractive.

Larch makes up half or more of the timber volume on 2.6 million acres of forest land in western Montana. Its principal associate is Douglas-fir, which accounts for about one-third of the volume in larch stands. Larch is a pioneer tree that reestablishes itself best on areas burned to the mineral soil and on which there is a minimum of shade. Because young larch will not grow in the shade of a parent stand, the species forms a so-called temporary type; that is, it gradually gives way to more tolerant trees—principally Douglas-fir—if the stand is not disturbed. A typical virgin larch stand is shown in figure 19.

Lodgepole Pine

Montana's supply of lodgepole pine saw timber is 6.9 billion board feet, approximately one-third of the total saw-timber volume of this species in the United States. Two-thirds of the Montana volume lies east of the Continental Divide.

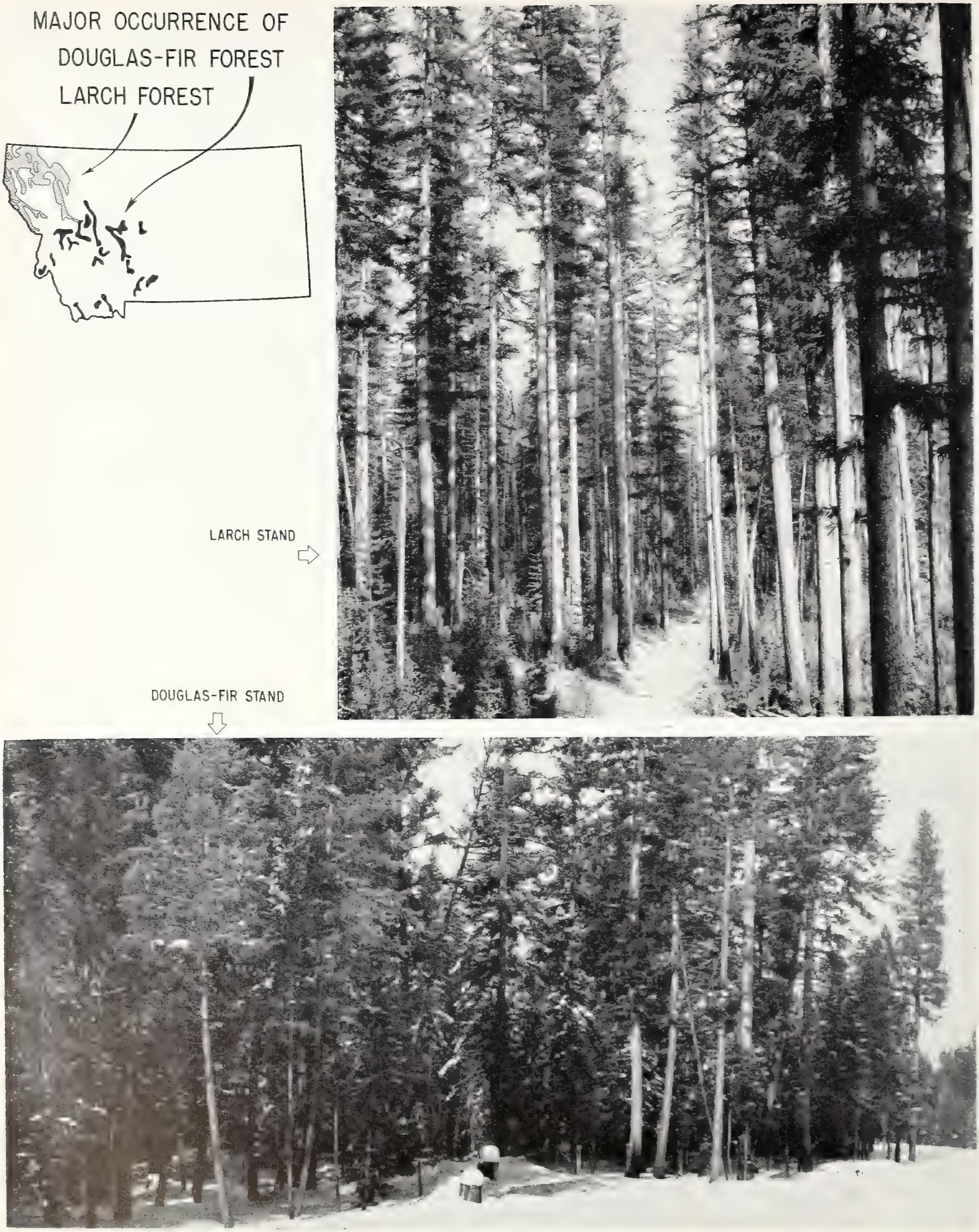

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FIGURE 19.—*Typical stands of larch and Douglas-fir.*

A prolific, aggressive tree, lodgepole pine has taken over much of the vast area swept by fires in years past. Today, forests dominated by this species cover a greater area than any other commercial type in the State—about 4.6 million acres. In eastern Montana one-third of the commercial forest is lodgepole pine.

One of the outstanding features of the commercial forest of Montana is that most of the area is well covered with tree growth. Despite extensive severe fires, only 3 percent of it, excluding woodlands, has so few trees as to be classed as nonstocked or de-forested. This situation is attributable in large part to the prolificness of lodgepole pine and its weedlike capacity to thrive on burned-over areas. Dense, pure stands of lodgepole pine, such as shown in figure 20, have sprung up on innumerable burns. The ease with which this species reproduces has, however, been a disadvantage as well as an advantage. Many stands, overcrowded to start with, have in later years stagnated. One of the management problems in the lodgepole pine type is to keep the number of stems down to where individual trees can grow rapidly to merchantable size.

Like some of the ponderosa pine, much of the lodgepole pine is growing on land which, from an ecological standpoint, belongs to other species. Lodgepole pine has been called the great visitor that comes to see the fire and stays for a rotation. In the absence of future fires, other species will normally take over many areas presently bearing lodgepole pine.

Lodgepole pine is typically a small tree. The average saw-timber tree of this species has a diameter of approximately 12 inches as compared with approximately 20 inches for ponderosa pine saw timber. Only 1 percent of the lodgepole pine saw-timber volume is in trees larger than 20 inches. This is in contrast to the larch saw-timber volume, 72 percent of which is in trees larger than 20 inches. Only its small size in a western forest of giants has kept lodgepole pine from being heavily cut for lumber. Its properties are very similar to those of ponderosa pine.[9]

During the past half century an enormous area of overmature lodgepole pine forest has been swept by waves of dendroctonus beetles. Most of the timber killed by these beetles has long since fallen to the ground and deteriorated beyond salvage. However, Forest Survey measurements indicate that 361 million cubic feet of dead lodgepole pine might still be used for pulping and certain other purposes. The volume of this salvable dead wood is about one-tenth as large as the green lodgepole pine volume.

Spruce

From the standpoint of quantity, spruce is the fifth most important tree in the commercial forest of Montana. The 7.0 billion board feet of spruce saw timber in the State is approximately one-fifth of the total volume of spruce in the Western States. No estimate of the eastern spruce volume is available, but it is probable that at least 13 percent of the total spruce saw-timber volume in the United States is in Montana.

Two species of spruce grow in the State: Engelmann and white. Actually, the distinction between these species is an academic one, for the two woods are very similar. White spruce, though it occurs in several localities, is a minor quantity.

Spruce grows primarily at higher altitudes. Cunningham, et al (2), found that "The lower range is confined to moist canyons or protected north slopes, while on other exposures it finds sufficient moisture only at higher altitudes. . . . It is found in greater abundance and of better development in the forests bordering the Canadian boundary than elsewhere and appears to attain the largest dimensions on the deep-soiled springy slopes and along canyons." Because spruce has an affinity for the higher areas which lack roads, it has been little used.

Other Conifers

The range of white pine, hemlock, grand fir, and western redcedar, which flourish in northern Idaho, extends into the western edge of Montana. From the standpoint of area, these are minor species predominating on only 357,000 acres or 2 percent of the commercial timber-growing area. However, the 2 billion board feet of saw timber of these species is almost 4 percent of the total saw-timber volume in Montana. White pine (fig. 21) and its three associates occupy some of the most productive forest land in the State. This is shown in the

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[9] The versatility of this species was described by I. V. Anderson in a talk entitled LODGEPOLE PINE: A MULTIPLE-PURPOSE WOOD, given before the Washington-Idaho-Montana Dry Kiln Club at Libby, Mont., in August 1949.

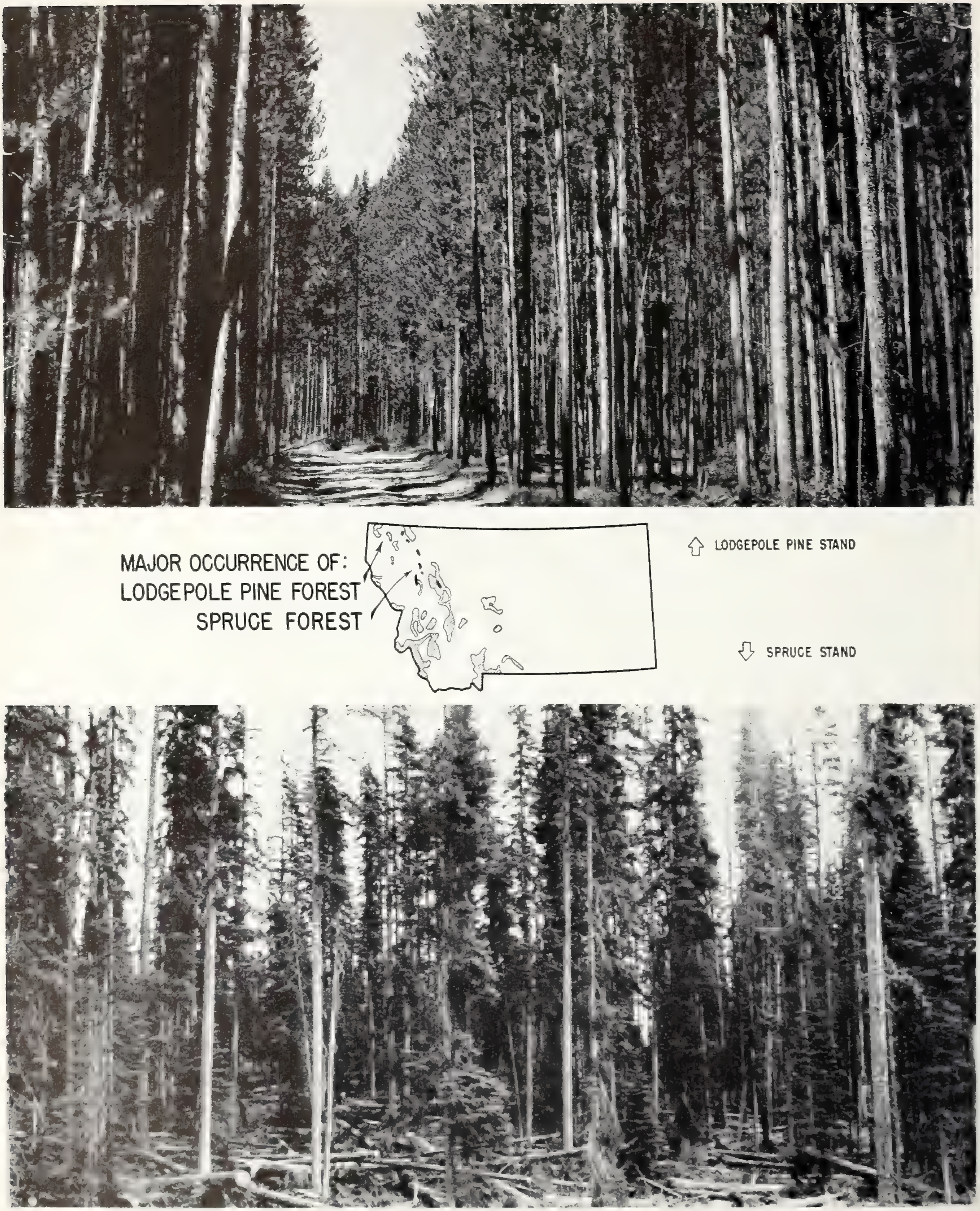

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FIGURE 20.—*Lodgepole pine and spruce stands.*

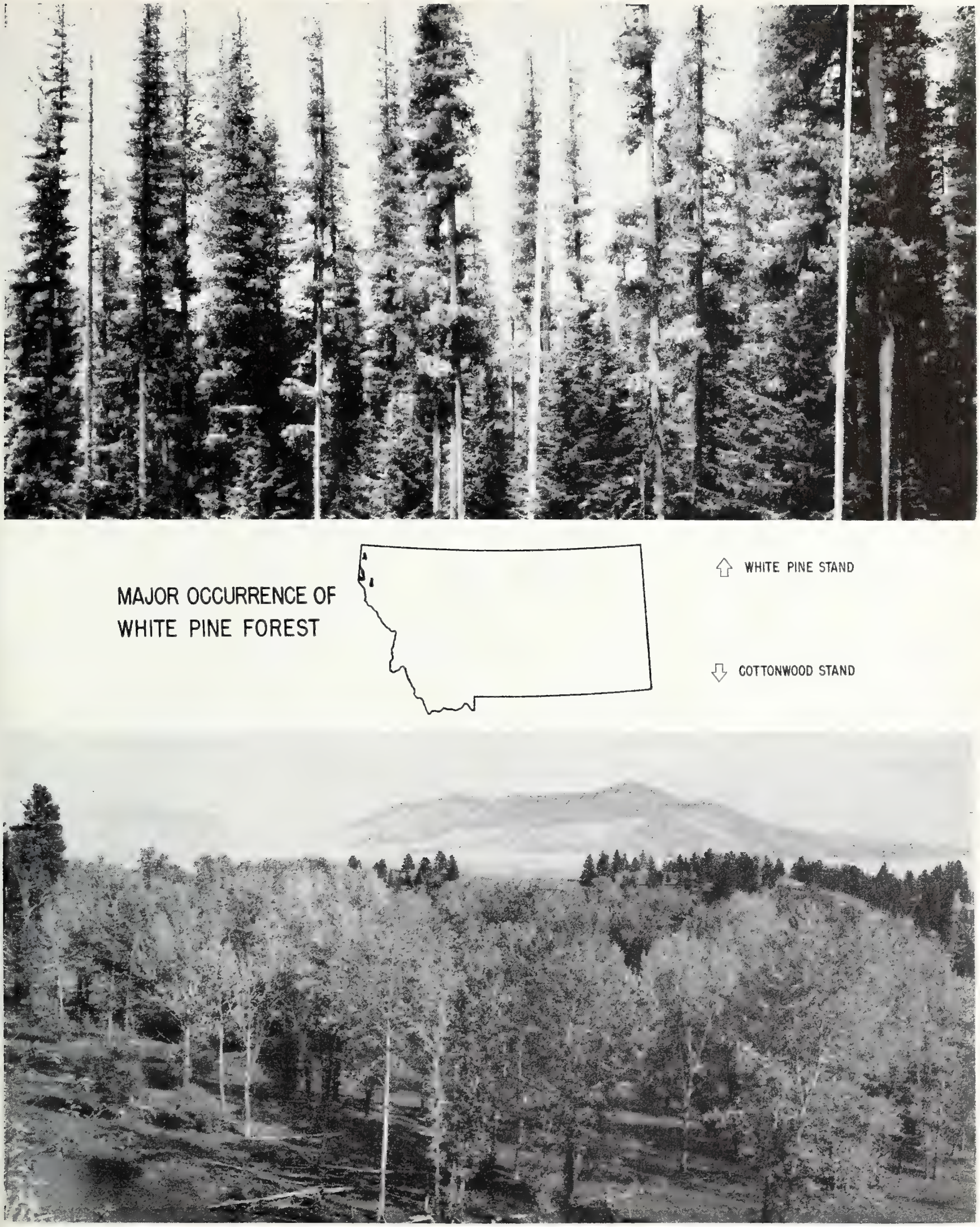

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Figure 21.—*White pine and cottonwood stands.*

following comparison of potential annual-growth capacities for forest type classes in western Montana: white pine, redcedar, and hemlock-grand fir, 73 cubic feet per acre; spruce, 67; ponderosa pine, 40; larch, 40; Douglas-fir, 26; and lodgepole pine, 20.

Alpine fir is common at the higher elevations, although individual trees are found almost to the valley floor, down many north slopes, and along stream bottoms. Much of the alpine fir is in noncommercial areas. However, 610 million board feet is found on commercial areas. The tree itself is considered to be of low quality and is little used. It is, nevertheless, suitable for pulping.

Whitebark and limber pines likewise occur widely throughout the eastern Montana forest and to a smaller extent in western Montana. The total volume of these two species in the State is 628 million board feet. Much of the timber is scrubby and not very usable. However, on areas where growing conditions are favorable, whitebark and limber pine timber possess qualities comparable to some of the best found in western white and ponderosa pines.

Hardwoods

The hardwoods of the East and West meet in eastern Montana. Aspen, cottonwood, boxelder, green ash, willow, birch, and elm are all native to the State. However, only cottonwood occurs in sufficient volume to be important. The total hardwood saw-timber volume in Montana is 695 million board feet, of which 677 million is cottonwood. Three-fourths of the Montana cottonwood is east of the Continental Divide.

Cottonwood is the only tree in Montana native to every county. Scattered widely along the streams and rivers, it occurs in largest quantities in some of the major river bottoms. In pioneer days the boilers of river steamers on the Missouri were fired with cottonwood. Today it is used for lumber, fence posts, and fuel wood. Montana's cottonwood is of three species: northern black, narrowleaf, and plains (fig. 21).

Character of the Commercial Stands

The retarded utilization of the Montana forest is reflected in a stand condition very different from that in much of the rest of the Nation. In the eastern regions of the United States most of the timber capital has been depleted by heavy cutting. Consequently, those forests are producing at part of capacity and can be restored to full production only by building up the saw-timber growing stock. That is a long, slow process. The Montana forest, in common with the forests of the other Rocky Mountain States, has an excess of mature and nearly mature timber (fig. 22).

A detailed tally by age class in western Montana shows that almost half of the timber area in that part of the State bears stands older than 120 years, and that one-fourth of the area bears stands more than 200 years old. Such proportions are considerably in excess of requirements. The saw-timber volume in Montana amounts to 8,100 board feet per acre of saw-timber stands and 3,700 board feet per acre of total commercial forest, excluding woodland areas. East of the Mississippi River the average is 1,600 board feet per acre of commercial forest. The classification of the Montana commercial forest, with the exception of woodlands, by size of timber, is as follows:

	Western Montana (million acres)	*Eastern Montana (million acres)*	*Total (million acres)*
Saw-timber stands	3.7	2.0	5.7
Pole-timber stands	3.0	3.4	6.4
Seedling and sapling stands	1.8	.6	2.4
Nonstocked areas	.4	.1	.5
Total	8.9	6.1	15.0

Another notable fact is that the area of nonstocked forest land is small even though there have been many and extensive fires in years past. This is largely due to the great capacity of several species, particularly lodgepole pine and larch, to reseed on burned areas. Montana's commercial forest, in addition to having only a relatively small denuded acreage, is for the most part satisfactorily stocked. Complete stocking data are available only for western Montana. They show that 86 percent of the area of pole and seedling and sapling stands in that part of the State is medium- to well-stocked with trees.

In addition to the nonstocked area, there are 800,000 acres of woodland in eastern Montana that are also less than 10-percent covered with trees. The lack of timber on the so-called woodland areas, however, has nothing to do with past fires, other damage, or cutting. It merely reflects the fact that these areas are on the lower end of the scale of commercial quality and productivity.

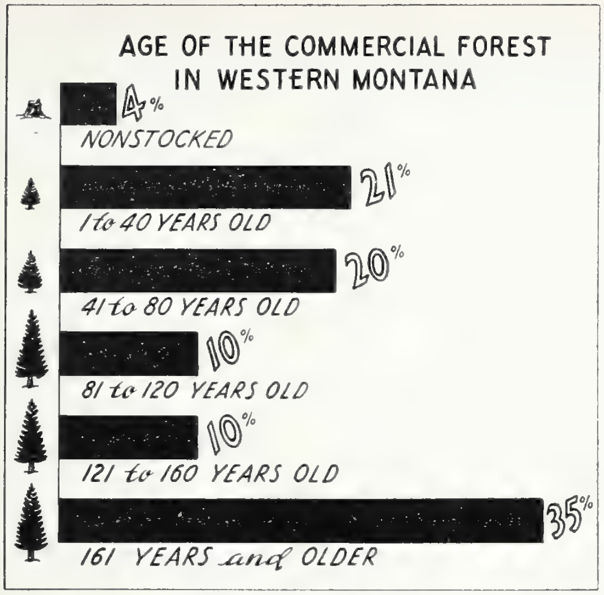

FIGURE 22.

The Volume of Timber in Montana

Approximately 93 percent of the timber cut in Montana is from live, sound trees of saw-timber size of which there are 56 billion board feet. It is to be expected that a large part of the timber production will always come from saw-timber trees. However, there is an additional and only partially tapped supply of wood in pole-timber, dead, and cull trees which is suitable for certain purposes. A large part of the mature lodgepole pine, for example, is only pole size, that is, 5.0 to 11.0 inches in diameter. Many other stands need to be thinned, and they would provide a substantial volume of usable wood of all species.

As shown in the following tabulation, the total stand of live and dead timber in the State is 17 billion cubic feet.

	Total timber stand in Montana	
	Billion cubic feet	*Percent*
Sawlog portion of saw-timber trees	8.1	48
Pole-timber trees	7.2	42
Cull trees	.3	2
Dead trees	.5	3
Top portion of saw-timber trees	.9	5
Total	17.0	100

Though much of this timber is growing stock that should not be cut for many years, it is apparent that the existing timber volume as a whole is more than ample in relation to the use which has so far been made of it. The total cut of live and dead timber of all kinds has averaged less than 100 million cubic feet per year. Thus, if size and quality could be disregarded, there is enough timber to keep logging operations going at the present rate for 170 years or more without any additions to the volume by growth.

Although only 3 percent of the total usable volume in the State as a whole is dead wood, the situation varies considerably by locality. In Beaverhead County, for example, 14 percent of the usable timber of all species and 20 percent of the lodgepole pine are dead.

Two-thirds of the dead timber in Montana is lodgepole pine killed by the mountain pine beetle (*Dendroctonus monticolae*). In 1909 an infestation of this beetle was reported on what is now the Flathead National Forest. That was the beginning of an epidemic which eventually swept southward across the western part of the State into the Bitterroot Valley and Big Hole Basin. During the three decades the epidemic raged, it killed billions of board feet of mature timber, mostly lodgepole pine. This single epidemic probably killed as much or maybe more lodgepole pine of saw-timber size than is standing today. Figure 23 shows the general location of the major bodies of dead timber in the State.

Timber Growth in Montana

Net annual growth of all timber 5.0 inches and larger in Montana is 241 million cubic feet, nearly 2 percent of the total for all of the United States. The net annual growth of saw-timber trees in Montana is 606 million board feet, about 1½ percent of the national total. These are indeed small percentages, considering that approximately 3½ percent of the Nation's commercial forest lies in Montana. This situation is accounted for first by the fact that Montana forest land at its best will not grow timber as fast as the forest land of several other regions. Secondly, growth in Montana is currently low because the forest is in an undeveloped condition, much of it being overmature and slow growing. Figures are not available to show what portion of the total growth capacity in the United States is in Montana, but there is no question but that the following figures will be considerably exceeded as the Montana forest is cut over and restocked with thrifty stands.

	Net annual growth of live saw timber and primary growing stock	
	Live saw timber (million bd. feet)	*Primary growing stock (million cu. ft.)*
Western Montana	346	97
Eastern Montana	260	144
Total	606	241

At present 60 percent of the net cubic-foot timber growth in Montana occurs east of the Continental Divide. This may seem strange, considering that only 43 percent of the commercial forest area lies in eastern Montana and that this forest has on the average a substantially lower growth capacity than the forest of western Montana. Here again the answer lies in the character of existing stands. One-third of the saw-timber area west of the Divide is overmature, growing slowly, and suffering heavy losses from insects and disease. This overmature condition is much less common in eastern Montana. Proportionately, much more of the eastern Montana commercial forest bears young stands, many of which are in the stage of most rapid growth.

The cutting of the overmature stands in western Montana is gradually changing the picture, and in the long run we may expect the net annual growth there to be substantially higher than in eastern Montana. As a matter of fact, inasmuch as the western Montana estimates are based on measurements made in the middle thirties when precipitation was below normal, current annual growth in that area is no doubt somewhat higher than indicated. The majority of growth measurements in eastern Montana were made following World War II, during a period when precipitation was slightly above normal.

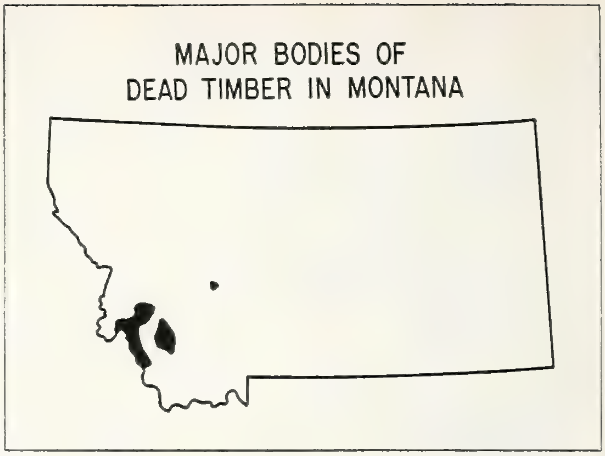

Figure 23.

Montana's Forest Industries

MORE than 400 sawmills and at least 75 other wood-using plants operate in Montana. The output of all forest industries in 1948 was valued at 50 million dollars. These industries are a major source of employment and income for many communities.

Lumber is the principal wood product in Montana, and lumbering the principal manufacturing industry. A number of other forest commodities are also produced: mine timbers, transmission poles, pulpwood, fuel wood, posts, lath, shingles, hewed ties, converter poles, corral poles, and Christmas trees.

The Lumber Industry

Since the 1840's when the Jesuit Fathers in the Bitterroot valley flattened out a wagon wheel tire and cut sawteeth in it, the lumber industry has come a long way. Their crudely constructed sawmill was the first. The next one was brought to Montana in 1863 by two men, Holter and Evenson. Hitched behind a yoke of oxen, this mill was hauled more than 1,000 miles from Denver, Colo., to Madison County. It was in operation in 1864 and the first boards sold for a top price of $140 per thousand board feet (*5*). From such humble beginnings the lumber industry has grown to a 45-million-dollar business.

Early production records show that Montana mills sawed about 13 million board feet of lumber in 1869. By 1900 production exceeded 200 million board feet, and continued generally upward to a peak of 427 million board feet in 1923. Lumber output took a sharp slump during the depression, dropping to a little more than 100 million board feet in 1932. Following this, production headed upward again to a new peak of 598 million board feet in 1948 (fig. 2, p. 4).

Size of Montana Sawmills

Lumbering in Montana is in its third phase of development. The first phase was the operation of the pioneer mills, such as the one run by Holter and Evenson. The second phase, from about 1890 to 1925, was that of the large mill, during which big plants were constructed in Libby, Eureka, Troy, Missoula, Hamilton, and several other towns. According to the lumber census of 1921, large mills accounted for 75 percent of the lumber production in that year.[10] The third phase began after 1925. Large mills dropped in number from 7 to 5 in 1948 and their production fell off proportionately. During the quarter century following 1925 many smaller plants were established and their combined output in 1948 was over 300 percent higher than in 1926.

In 1948 the most important segment of the lumber industry was the medium-size mills which produced 48 percent of the lumber cut (fig. 24). Just how much the center of gravity shifted between 1921 and 1948 is shown in figure 25 and in appendix table 23.

The larger mills that have closed over the years appear to have done so because of their inability to get enough ponderosa pine at a time when it was difficult to market timber of other species. The two largest sawmills in Montana today, the Bonner plant of the Anaconda Copper Mining Co., and the Libby plant of the J. Neils Lumber Co., have been favored with a backlog of ponderosa pine timber. Both also have had relatively good outlets for sawed material of other species. The Bonner mill saws much larch and Douglas-fir for the Butte mines and the J. Neils Lumber Co. has developed a market

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[10] The term "large mills" as used here includes plants producing 10 million board feet or more annually; medium mills, 1 million to 10 million board feet; and small mills, under 1 million board feet.

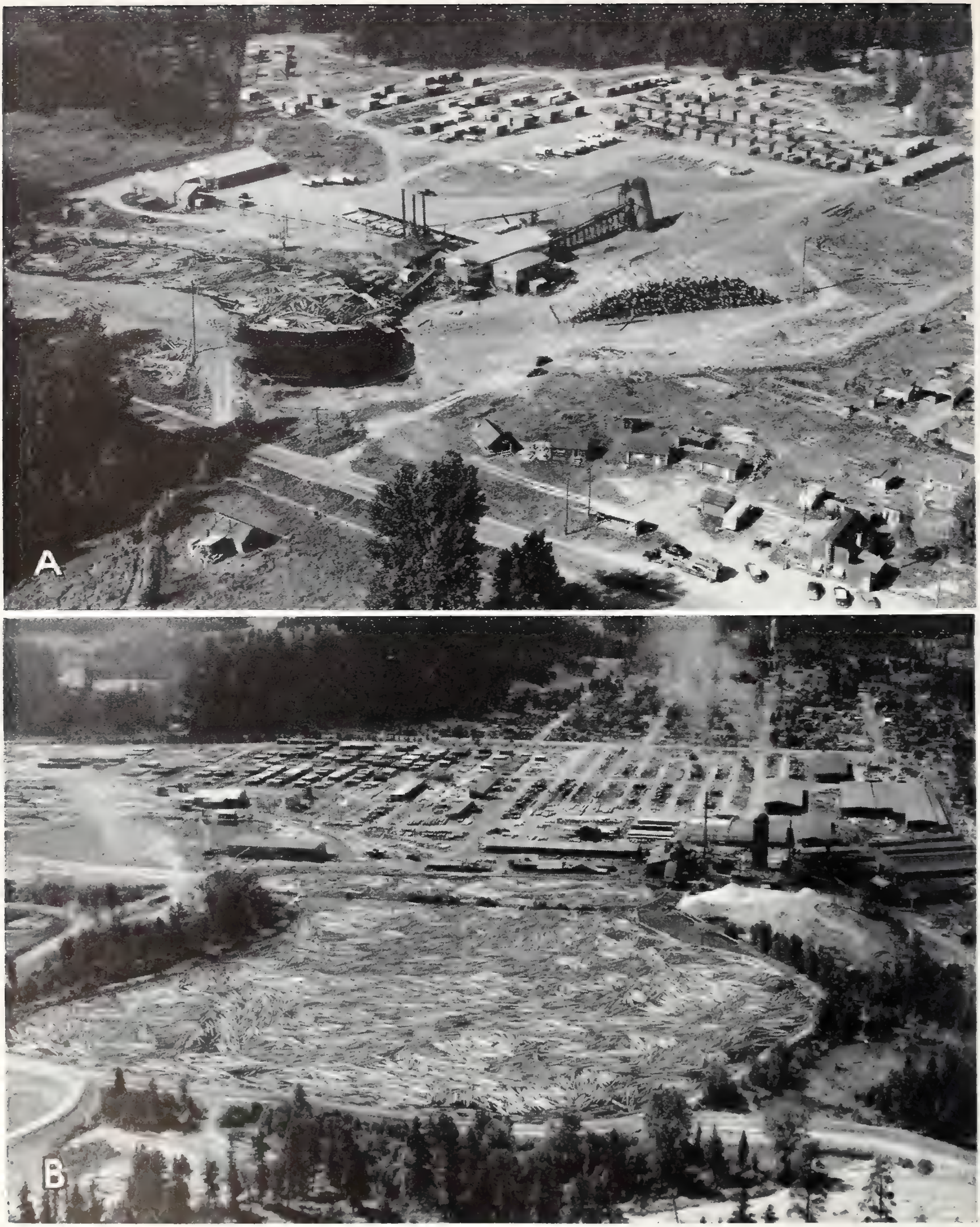

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FIGURE 24.—*A, A modern medium-size sawmill of the type that is taking on greater importance in the lumber industry. This is a band mill. B, A large-size sawmill, one of the few remaining in the State. Diversification, remanufacture, precision manufacturing, adequate capital, and established outlets are some of the factors accounting for the long-time stability of these plants.*

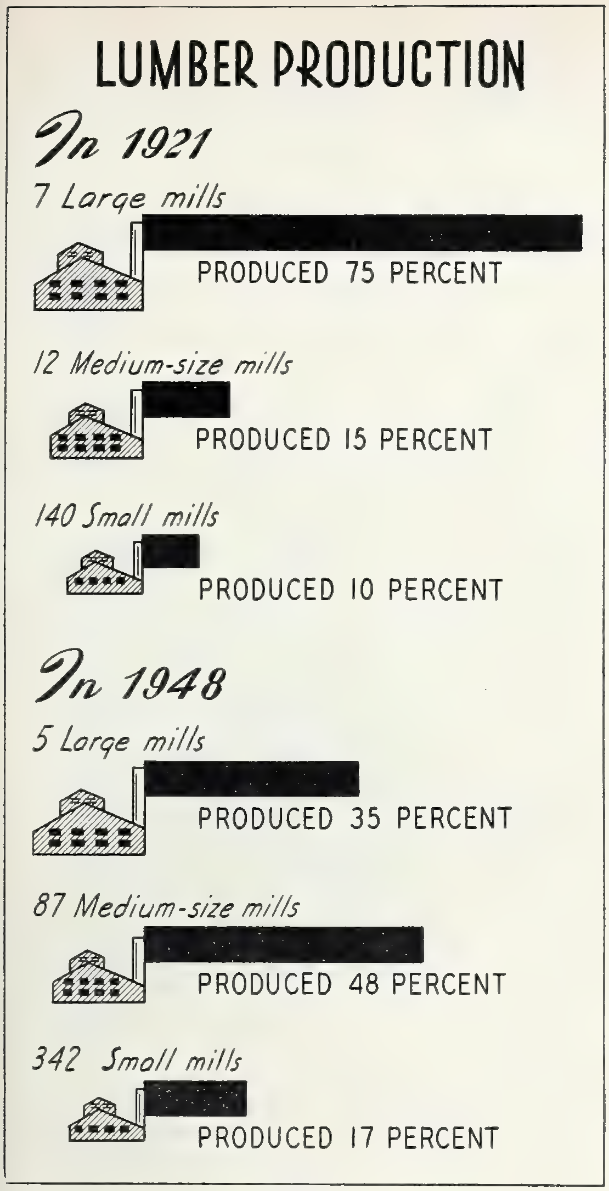

FIGURE 25.

for lumber of these species through an aggressive sales program.

The changing character of the lumber industry has both its good and bad features. Small plants have the operational advantage of lower overhead, and an industry of small businesses offers wide opportunity for individual enterprise. On the other hand many of the smallest mills are marginal. When markets are good, they run; when markets are poor, they shut down. Lacking mechanical improvements and a large volume of output, they are in a less favorable position to operate with maximum efficiency than are the larger mills. Perhaps the greatest handicap of smallness is in obtaining efficient management; it is far easier to find management ability for 1 large mill than it is for 10 small ones.

In view of the problems which seem to be in inverse ratio to mill size, the sixfold increase in number of medium-size mills is most encouraging. While these mills are small in comparison with the mills that dominated the western lumber industry in the past, they are not the smallest. Many of them are large enough to permit the installation of dry kilns, resaws and other mechanical aids. Such utilization opportunities make it feasible to build this segment of the industry into an efficient, stable group of plants.

Concentration yards, which buy up rough green lumber and dry, dress, and market it, are overcoming some of the disadvantages of small mills. Though concentration yards have long been an institution in the South, they have only recently become important in Montana.

Lumber Production by Species

Except for some cottonwood cut by small sawmills in the river bottoms of eastern Montana, nearly the entire lumber production of the State is from coniferous timber. Three species, ponderosa pine, western larch, and Douglas-fir, make up nearly 95 percent of the cut. White pine, spruce, and lodgepole pine are sawed by numerous sawmills in the western part of the State, but the total output of these species is relatively small.

Since 1904, with the exception of 4 years, the cut of ponderosa pine has exceeded that of any other species. Western larch has generally been second and Douglas-fir third. The most significant point, however, is that western white and ponderosa pine, which together make up 22 percent of the saw-timber stand, have in the past half century accounted for 47 percent of the lumber cut. This situation has arisen from differences in marketability of the various species.

Western white pine lumber has always been of sufficient value to pay the high cost of freight to midwestern and eastern markets and still leave a profit for the producer. Ponderosa pine has ranked a little below western white pine in this respect. The other timber species, however, lack the special qualities of western white and ponderosa pine and have been less able to pay their way. Fortunately, the mining industry and the railroads have provided a local market for much lumber of these less valuable species.

During the war and postwar years the proportion of larch, Douglas-fir, and other less valuable species in the lumber cut increased. In 1948 these species accounted for 60 percent of the total lumber production as compared with 48 percent in 1937. This change was due to the outstandingly strong postwar lumber market and the reduction of the western white and ponderosa pine timber supply. Major dependency, nevertheless, still rests upon the two pines even though they account for less than half of the cut.

The over-all timber supply situation in the United States is a basis for thinking that the market position of the less valuable species will continue to improve. However, if there are periodic slumps in the lumber market in the future as there have been in the past, they will undoubtedly have a less adverse affect upon ponderosa and western white pine lumber than upon lumber of the less valuable species. Thus, the lumber industry will be more stable and profitable in the future if it has ponderosa and western white pine timber to cut.

Markets for Montana Lumber

The miner was the lumber industry's best customer for many years. Later the railroads became important wood users and also provided access to outside markets. Still later with the great settlement period following the turn of the century, Montana farmers and ranchers began to use a large quantity of lumber. Today a little more than half of the lumber cut is used within the State (fig. 26), the railroads being the principal consumers. Other in-state consumers or types of use are, in order of their importance: farms, mines, remanufacturing, and nonfarm construction. As a group these users plus the railroads account for about 90 percent of the in-State consumption.

Montana lumber is shipped all over the Nation. A survey in 1945 showed sawmill shipments to 40 of the 47 other states, with 71 percent going to the Midwest (fig. 27). Minnesota, Illinois, Iowa, Wisconsin, and Pennsylvania were, in that order, the principal markets in 1945. Fourteen percent of the 1945 shipments went to the West, 13 percent to

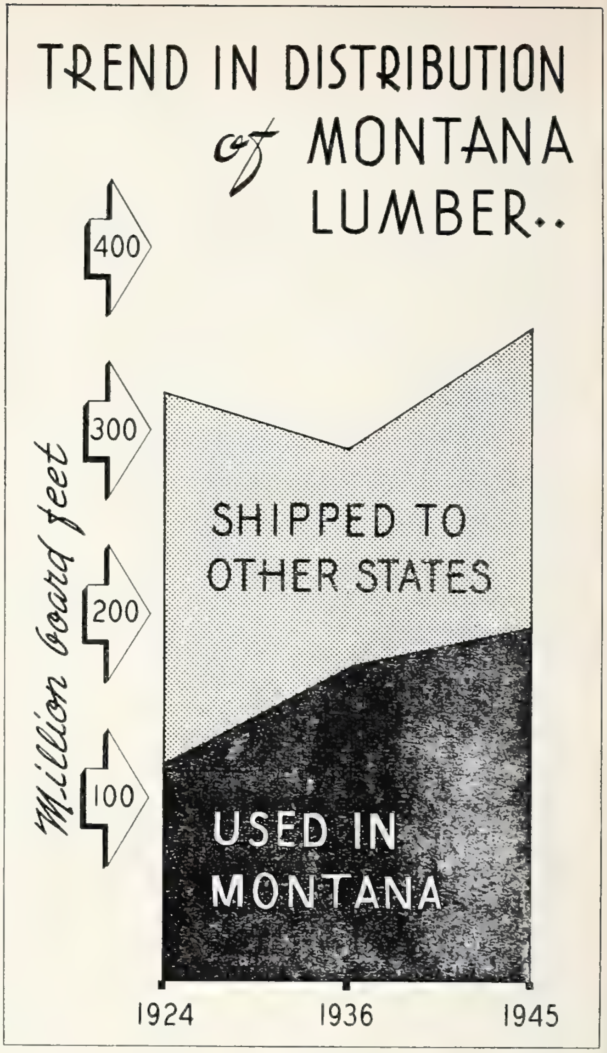

FIGURE 26.

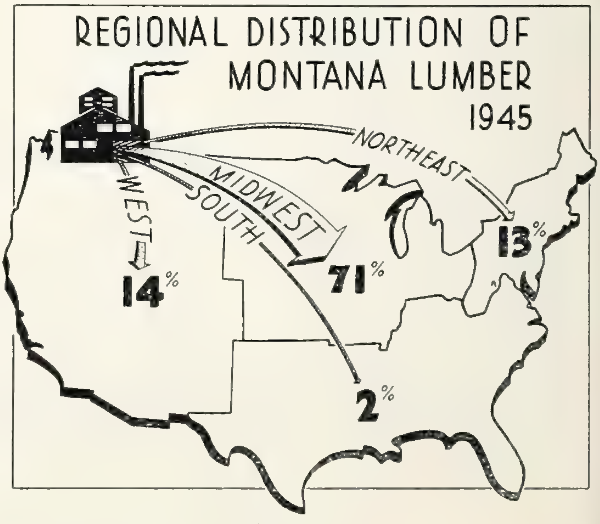

FIGURE 27.

the Northeast, and 2 percent to the South. This general pattern of distribution, which has prevailed for more than 20 years, is due largely to the competitive position of the Montana industry in relation to South and west coast mills.

Railroad Tie Production

Cross ties constitute a sufficiently important part of the lumber output in Montana to warrant special mention. They have been a major item of wood use ever since railroads began to replace river steamers and covered wagons. As the transcontinental lines headed westward across the Plains States during the latter part of the last century, the requirements for ties were tremendous. Even before the rails reached to Montana's forest areas, ties were being hewn on the eastern slopes of the Rockies and driven down the Missouri and Yellowstone Rivers. Evidence of these early cuttings can still be seen in many of the remote areas of the Sun, Gallatin, and Yellowstone River drainages.

It was not, however, until the midtwenties that cross ties became a big item of production in Montana sawmills. Almost all of the ties cut in the earlier years were hewn by tie hacks, and as late as 1925 about 900,000 hewn ties were being cut annually. This was slightly more than 40 percent of the total tie output. The production pattern shifted rapidly, and by 1931 hewn ties made up about 1 percent of the total, all the rest coming from sawmills. The shift to sawed ties brought a concentration of tie production to the northwestern counties—Flathead, Lincoln, Lake, and Sanders. Here are located two tie concentration yards with preservation plants. Here also are large areas of larch and Douglas-fir, species which because of their strength and durability are preferred by the railroads. In recent years larch and Douglas-fir ties have constituted nearly one-fifth of the total sawmill output in the State.

Production of sawed ties has become a specialty trade for a number of small mills; portable equipment and crews of usually not over six to eight men are typical. Cutting from 2,500 to 12,000 ties per setting, these small mills move rapidly from one tract to another. In 1946 there were about 35 of them. Their operation has been notably unstable. Annual sawed-tie purchases from 1942 to 1947 ranged from 42 million to 97 million board feet. The worst feature of such fluctuation is, of course, its adverse effect on the income of dependent communities.

In cutting ties, the outer part of the log is either tossed to the slab pile or sawed into boards. For each 1,000 board feet of ties sawn, it is possible to cut nearly 250 board feet of lumber, commonly referred to as side lumber. Tie sides from larger larch trees yield 40 percent in clear grades. The controlling factor as to whether side lumber is to be sawn is usually the market price of larch and fir boards. When the price is relatively low, tie sides go to the slab pile; when the price is good, side lumber is sawn. During most years the market has been so poor that much high-grade wood has been sold for fuel or left to rot in the woods.

The Mine Timber Industry

Approximately one-fifth of the output of Montana's sawmills is used by the mining industry in the form of heavy timbers, planking, lagging, or other lumber. In addition, some 3 million cubic feet of round and hewed material are used underground each year in the production of metal ore and coal. The mine timber industry has grown up to meet this need.

In the early days of metal mining in Montana sawed mine timbers were used to a greater extent than at present (*10*). As the price of sawed timber increased, however, round timbers began to be used more. Unlike the hewn tie which has almost gone out of existence in this region, the round mine timber has stayed in favor because it has been the cheapest material for the job. Recently one company has been experimenting with slabbed stulls, that is, round stulls roughly squared to facilitate packaging and handling.

Lodgepole pine was at one time the principal species used underground, because the forests in the vicinity of the metal and coal mines were principally of that species. According to Rapraeger (*10*), this situation changed about 1916 when the copper market of World War I created an unprecedented demand for mine timbers which local suppliers could not meet. It became necessary for some of the mining companies to reach out into the larch-Douglas-fir forest for timber. Since freight rates were favorable and two of the major mining companies owned extensive tracts of larch and Douglas-fir, the market lost by lodgepole pine was never regained. Today more than half of all the round timbers produced in Montana are larch and Douglas-fir, mainly the latter.

The Anaconda Copper Mining Co., which uses most of the round timbers in the State, obtains the greater part of its supply in western Montana although its operations are widely scattered. The smaller concerns generally obtain timbers in the vicinity of their mines. Three-fourths of Montana's mine timbers are produced in the western part of the State.

The Pole Industry

Prior to World War II some 20 to 30 thousand telephone and light poles (mainly western redcedar) were cut annually in Montana. The short supply of redcedar timber, the preferred species for poles, and also the lack of processing and treating plants kept pole production at a low level. Between 1945 and 1948 10 processing and treating plants were built—6 in western Montana and 4 in eastern Montana—and the pole industry came into its own. These plants, plus the additions to those already established, involved a capital investment of 1½ million dollars. In 1947 the industry produced 325,000 poles. Production slipped badly in 1948 because of unfavorable market conditions, but rose again to 222,000 pieces in 1949 (appendix table 25).

The expansion of this industry was based primarily on the utilization of lodgepole pine timber. Growing straight and slender in dense stands and having a high proportion of the desired 30- to 40-foot lengths and 8- to 12-inch diameter classes, lodgepole pine has the qualities needed to make good telephone and power poles at a low cost. Nearly one-third of the lodgepole pine timber in the United States is located in Montana, so with the rapid depletion of redcedar in other Western States the growth of Montana's pole industry was a natural development.

A greatly expanded rural electrification program, beginning in 1945 stimulated the rapid growth of the Montana pole industry. Although the proportion of farms in the United States which are electrified jumped from 11 percent to 87 percent in 15 years, there is still a big job to do in bringing adequate electric and telephone service to all rural homes. If new development proceeds at the rate planned by the Rural Electrification Administration, about 2,500,000 poles will be needed annually between 1950 and 1957. After that the demand is expected to drop to 1,500,000 poles a year.

Rural electrification and telephone cooperatives, of course, represent only part of pole requirements. There are some 55 million poles in service in the United States, exclusive of Rural Electrification Administration utilities. The annual replacement on these lines is estimated to be 2,700,000 poles annually.

Montana has sufficient timber to supply an even larger share of the Nation's pole needs than it has in the past. It is estimated that the annual cut of lodgepole pine alone can be stepped up four times and even then be well within the desirable cut limitation. The major problem of the industry is that of meeting strong competition from other producing States. Meeting competition will require a reduction in production costs, development of preservative treating processes to meet buyer specifications, and otherwise creating a demand for Montana poles.

Though Montana's big new market in recent years has been for small poles for rural lines, one company is attempting to develop outlets for western larch poles 45 feet and longer. Western larch is well suited for the production of such poles. It has a desirable shape and will produce a variety of sizes. Moreover, if properly treated, larch poles compare favorably with poles of other species in the matter of service life. These factors plus the increasing difficulty of finding adequate supplies of long poles in the South suggest a favorable market outlook. In 1949, 15 percent of the poles produced in Montana were western larch.

The Christmas Tree Industry

For more than 20 years Christmas trees have been an important product of Montana's forests. Nearly 3 million trees are shipped annually to midwestern and eastern markets. This is about one-seventh of the total production in the United States. The development of the Christmas tree industry in Montana is due primarily to the large number of Douglas-fir trees on low-site quality areas in the western part of the State. Growth on this land is sufficiently slow to produce the dense foliage desirable in Christmas trees. Some lodgepole pine trees have been shipped, but only on a trial basis.

Lincoln and Flathead Counties in the northwest corner of the State furnish about three-fourths of the trees shipped each year. About 70 percent of the trees come from private properties but in recent years cutting has been increasing on State and Federal lands. This industry, which employs about 2,500 workers for 2 months before Christmas and brings about 1 million dollars into the State, is a desirable one. Cutting of Christmas trees, like any cutting when properly done, adds to the productivity of the forest. It also provides employment during a slack period.

In 1948, Montana Christmas trees were shipped to 33 States, and a few carloads were exported to foreign countries. Five States, Illinois, Iowa, Missouri, Texas, and Kansas, received slightly more than half of the 1948 shipment.

In the midwestern market area where most of the Montana trees are sold, freight from most competing areas is less than from Montana. For example, from New Hampshire to Chicago the rate per hundredweight in 1949 was $1.29; from New Brunswick, $1.64; from western Montana, $2.22. These rate differences emphasize how necessary it is for the Montana industry to establish a reputation for high-quality trees and to keep prices at a reasonable level.

In recent years there has been some evidence that the quality of trees shipped from this State is declining. It is therefore clear that more effort must be made to grow better trees and to grade tree shipments. Growing better trees and more of them involves cultural practices such as thinning of thickets, leaving stumps with live branches to produce more trees, pruning of lower branches from thin-topped or badly formed trees, and in some cases planting to maintain full stocking. The adoption of Christmas tree grading rules is recommended to provide a basis for quality measurements.

Pulpwood, Fuel Wood, and Fence Posts

Montana does not have a pulp mill but it does produce pulpwood for export. For many years pulp logs have been shipped westward. During World War II the shipments reached a high of 15,000 cords, and in the 10 years from 1940 to 1949 averaged 8,400 cords a year. In 1945 wood-procurement problems caused several Wisconsin mills to look to Montana for pulpwood. Six-hundred-and-forty cords were shipped eastward that year. Despite the long haul of more than 1,000 miles, shipments to the Wisconsin plants climbed steadily to 50,000 cords in 1949. Figure 28 shows the trend of pulpwood production from 1940 through 1949.

Even in 1949 pulpwood constituted less than 5 percent of the timber-products output for the State. Since it takes approximately 130,000 cords of wood a year to keep a 200-ton sulfate pulp mill running, the construction of even one or two mills would make a major change in the character of the industrial drain upon the forest.

Montana produces 187,000 cords of fuel wood and 4,900,000 fence posts annually. All but a small part of the fuel wood and fence posts is consumed within the State, mostly near the locality in which they are cut.

Commodity Drain on Montana's Forest

Approximately eight-tenths of the timber removed from the commercial forest of western Montana is for lumber. In contrast, lumber use represents only one-tenth of the production east of the Continental Divide. In that part of the State

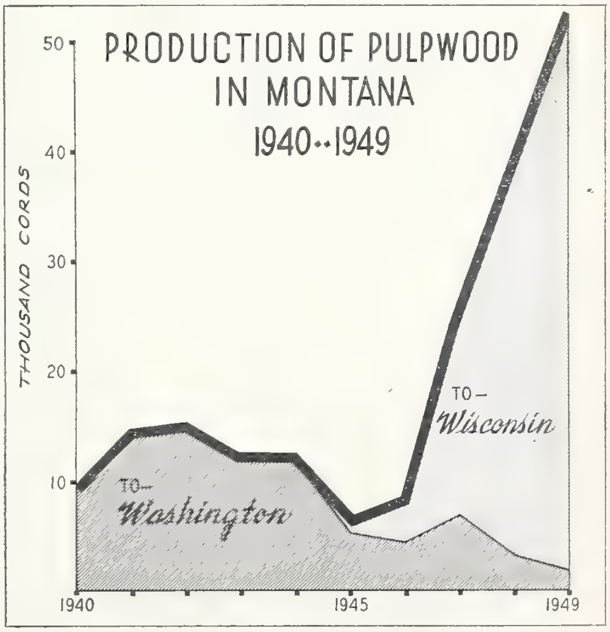

FIGURE 28.

more timber is being cut for each of three other products, fuel wood, posts, and pulpwood, than for lumber.

During the period from 1939 through 1948 an average of 94 million cubic feet of live, sound timber was cut yearly. This drain has two components which are discussed later. Ninety-three percent of the timber cut, or 528 million board feet, was of saw-timber size, that is, 11.0 inches in diameter and larger. The other 7 percent of the drain came from pole-timber trees, 5.0 to 11.0 inches in diameter, and amounted to 93,000 cords annually.

The average annual commodity drain on Montana's forest growing stock for timber products is as follows:

	Average annual commodity drain, 1939–48		
	Live saw timber (million bd. ft.)	*Live pole timber (thousand cords)*	*Total (million cu. ft.)*
Western Montana	479	38	81
Eastern Montana	49	51	13
Total	528	89	94

This excludes the production from dead and cull trees (primarily for fuel wood and fence posts) which amounts to almost one-tenth of the total production, but it includes logging waste, that is, live timber either cut or damaged beyond recovery in the course of logging operations but not used. Eighty-seven percent of the volume of the trees cut and damaged is taken out of the woods. The rest is left to rot.

Figure 29 compares the commodity drain with the growth figures presented earlier. In eastern Montana the volume of timber is increasing because of an excess of growth over drain. In western Montana the volume of all timber 5.0 inches and larger is likewise increasing, although the saw-timber volume is declining. Because the logging activity is on the whole poorly distributed in western Montana, many areas are being heavily cut and the saw-timber growing stock decline in these areas is even more rapid than for western Montana as a whole.

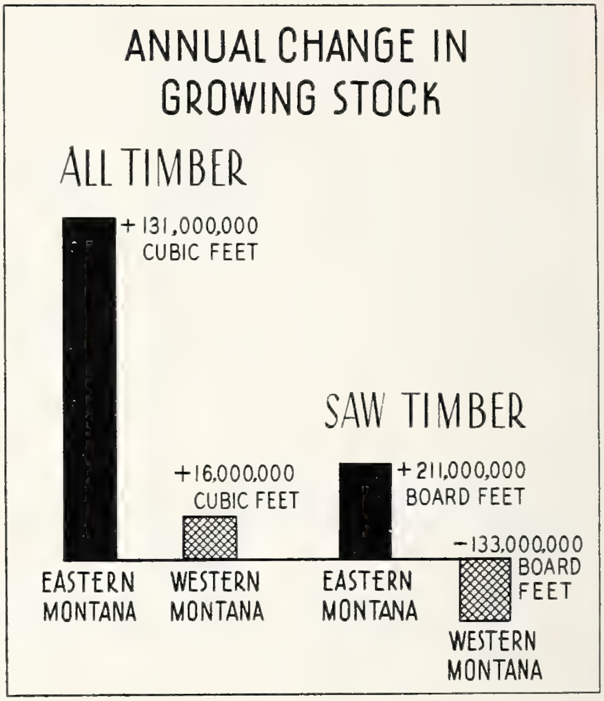

FIGURE 29.

Timber Supply and Industrial Development

INDUSTRIAL use of Montana's timber has been slow to reach the present level and even today is considerably below the productive capacity of the forest. No doubt the brightest fact in the forestry situation is that timber is available to sustain a larger forest industry. However, there are some qualifications that must be understood and taken into consideration. The opportunity for expanding the timber cut is contingent upon making more effective use of the forest. There are, in other words, four requirements that must be met if production of timber products is to be sustained at the level made possible by the growth capacity of the forest.

1. *Better distribution of the timber cut so far as species, size, and kind of trees are concerned.* A large part of the logging has been concentrated upon the more desirable timber, whereas use of the rest has lagged.

2. *Better distribution of the timber cut so far as area is concerned.* Many stands classed as commercial by the Forest Survey are not yet operable primarily because of a lack of roads. Unless the entire commercial forest area is utilized, the maximum timber cut cannot be sustained.

3. *More complete utilization of the trees logged.* In most logging operations the tops of the saw-timber trees are not utilized. These tops represent about 10 percent of the usable wood volume of the trees. Yield estimates in this report are based on the assumption that such material will be used in the future.

4. *Intensification of forest management and protection.* Much needs to be done to put the forest in a productive condition and to minimize losses. As in farming, forestry yields have a direct relationship to the amount of effort expended on crop culture.

The difficulties in attaining full forest productivity in Montana are by no means insurmountable. As a matter of fact, forest-management practices and protection are steadily improving, and there are hopeful signs that the economic handicaps which have held up development will lessen. Nevertheless, for a realistic view of the situation one should bear in mind that the allowable-cut[11] estimates in this report can only be justified if the four requirements mentioned above are met. There is a time element involved too. It is quite obvious that the improvements in management, protection, and development cannot be permitted to lag. If we drift along for several decades without making these advances, the allowable cut will be lower than indicated here.

Conditional Allowable Cut

The total conditional allowable timber cut in Montana is 250 million cubic feet a year, or 129 million cubic feet greater than the 1948 timber cut. As emphasized by the following tabulation and figure 30, two-thirds of the opportunity for expanding the cut is in types of wood only lightly utilized at present, namely, pole, dead, and cull trees and the tops of saw-timber trees.

	1948 cut (million cu. ft.)	*Conditional allowable cut (million cu. ft.)*
Sawlog portion of saw-timber trees	100	148
Pole-timber trees	9	55
Dead and cull timber and tops of saw-timber trees	12	47
Total	121	250

Saw Timber

The cut of saw timber reached an all-time high in 1948 but it was still below the allowable cut

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[11] The desirable level of cut is called "allowable cut." In stands in a depleted condition, the allowable cut should be less than the annual-growth rate to permit a build-up of growing stock. In stands where the volume of older timber is greater than necessary for sustained production, the allowable cut may be greater than the annual growth.

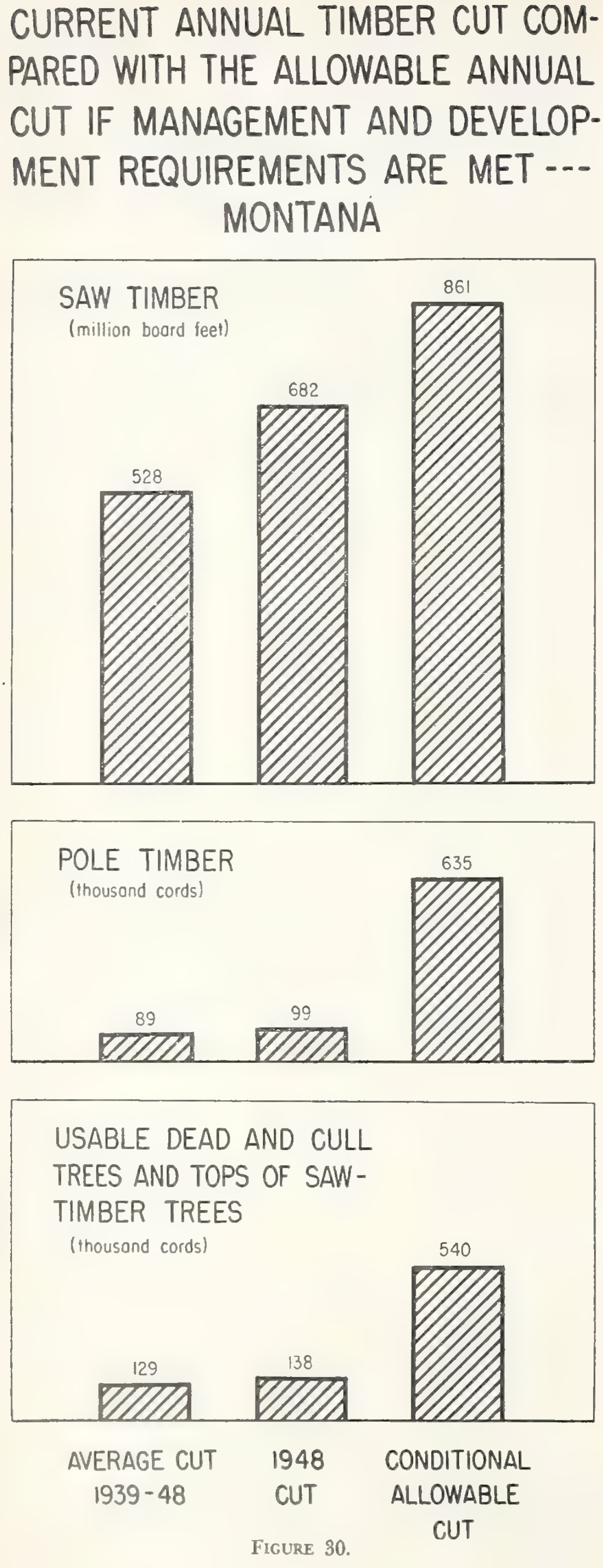

FIGURE 30.

for the State as a whole (fig. 30). As compared with an allowable cut of 861 million board feet the cut was 682 million. In eastern Montana, the cut of saw timber can be six times that of 1948. On the other hand in western Montana during 1948, the cut of all species *exceeded the allowable cut*—by 13 percent—for the first time. The opportunity for expanding the saw-timber cut is mainly in the smaller size saw-timber trees, 11.0 to 20.9 inches in diameter.

Pole Timber

In general, today's pole timber trees are tomorrow's saw-timber trees. Therefore, most of the pole-timber trees are growing stock and should not be cut. There is, however, a sizable volume of 5- to 11-inch timber that can be removed with benefit to the stands.

From an industrial standpoint, the most important part of Montana's merchantable pole timber is in lodgepole pine stands that have failed to reach saw-timber size even though they are mature, and in some cases overmature. The small size of the trees in these stands is due to three factors; the natural smallness of lodge-pole pine, the dense condition of some stands, and poor growing conditions (low site quality). Whatever the reason, this pole-size timber is ready for harvest and is excellent raw material for pulp and several other uses.

In addition to the more or less solid stands, pole timber is also scattered throughout the forest. Some of it should be thinned out of young stands to increase their growth rate. Some of it is poor-risk timber in older stands, and should be logged along with saw timber to make way for more vigorous trees. Comparatively little pole timber has been logged in the past and for that reason the opportunity for expanding the cut is even greater than it is for saw timber. In western Montana the allowable cut of pole timber is four times as large as the average 1939–48 cut; in eastern Montana it is nine times as large.

Any statement that more pole trees should be logged in the future than have been in the past needs careful qualifying. As pointed out earlier, most of the pole timber is growing stock—the source of future saw timber. Unless the pole trees to be cut are selected with discrimination, increased logging can do more harm than good. As a matter of fact, some harm has already been done. The extra good lumber market following World War II caused the premature logging of some vigorous, fast-growing, young ponderosa pine stands of pole size and slightly larger. Because such stands are in short supply, premature cutting of them undermines the future of established dependent saw-timber industries.

Dead and Cull Trees and Tops of Saw-Timber Trees

The usable portion of trees with rot and other defects, and trees killed by fire, insects, diseases, and other causes, is a wood source that has been little used. Lodgepole pine stands devastated by the serious insect epidemic that swept over Montana from 1909 to 1933 constitute the largest supply of dead timber. However, there is also much dead timber of other species.

Climatic conditions in the Rocky Mountains preserve fire-, insect-, and disease-killed timber for a long time. The remarkable lasting quality of much of this dead, standing timber is attributed to the drying out of the wood to the point where decay fungi cannot spread (7). Many larch trees that died in the first decade of this century still contain sound, usable wood. There is ample evidence that dead lodgepole pine in the high, dry forests of eastern Montana will last a quarter century or more. A recent study in Utah and Colorado reported cases of dead trees remaining standing and salvable for 70 years (7).

The dead timber is suitable for many uses. For example, tests of lodgepole pine for pulping show that it will yield pulp comparable to that from green wood of this species, except possibly for a slightly lower tearing strength.

The drawbacks of dead wood for pulp, poles, lumber, and other products are somewhat higher logging costs and greater wastage because of defects. The fact that much of the dead timber is scattered throughout green stands makes it desirable even from the operator's point of view to put it to use. Nevertheless, very little dead timber has been used for any products except fuel wood, fence posts, and stulls. Green timber is preferred because it is easier to use, there is still plenty of it, and it requires less care in selection.

The Montana forest can supply a substantial quantity of dead wood for many years. The salvage operation should grow smaller as time passes, because good management should eventually reduce widespread and devastating insect epidemics.

How much dead timber now standing can be made available and logged at a profit before it deteriorates is difficult, if not impossible, to say. Assuming that 5 percent of the existing volume is used annually, the annual cut for some years to come would be 311,000 cords—68,000 from western Montana, and 243,000 from eastern Montana.

The volume of cull timber is considerably smaller than that in dead trees. If it is utilized at the rate of 5 percent a year, the cut will be 127,000 cords—80,000 from western Montana, and 47,000 from eastern Montana.

Another source of wood is the top portions of saw-timber trees. At the present time, loggers in western Montana are utilizing the top portion of 1 tree out of 20. In eastern Montana about half of the top portions are utilized, chiefly because a large part of the cut is being used for pulpwood. The volume of the top portion of the allowable annual cut of saw-timber trees would be 102,000 cords—36,000 from western Montana, and 66,000 from eastern Montana.

The combined allowable cut of dead and cull trees and the top portions of saw-timber trees is estimated to be 540,000 cords; the actual cut in 1948 was 138,000 cords.

The Allowable Cut by Species and Ownership

The utilization of saw timber in Montana is very much unbalanced so far as species are concerned (fig. 31). Three of the high lights in the statistics for the 1948 cut are as follows:

1. The cut of ponderosa and white pine saw timber was 81 percent *above* the allowable cut.
2. The cut of larch and Douglas-fir saw timber was 3 percent *above* the allowable cut.
3. The cut of other species, mainly lodgepole pine and Engelmann spruce, was 85 percent *below* the allowable saw-timber cut.

The most disturbing feature in the Montana timber situation is the excessively heavy cut of ponderosa pine west of the Continental Divide. Since 1925, except for 4 years, the cut of ponderosa pine saw timber in western Montana has been higher than the allowable cut (fig. 32). While the overcutting of this species is offset to a small

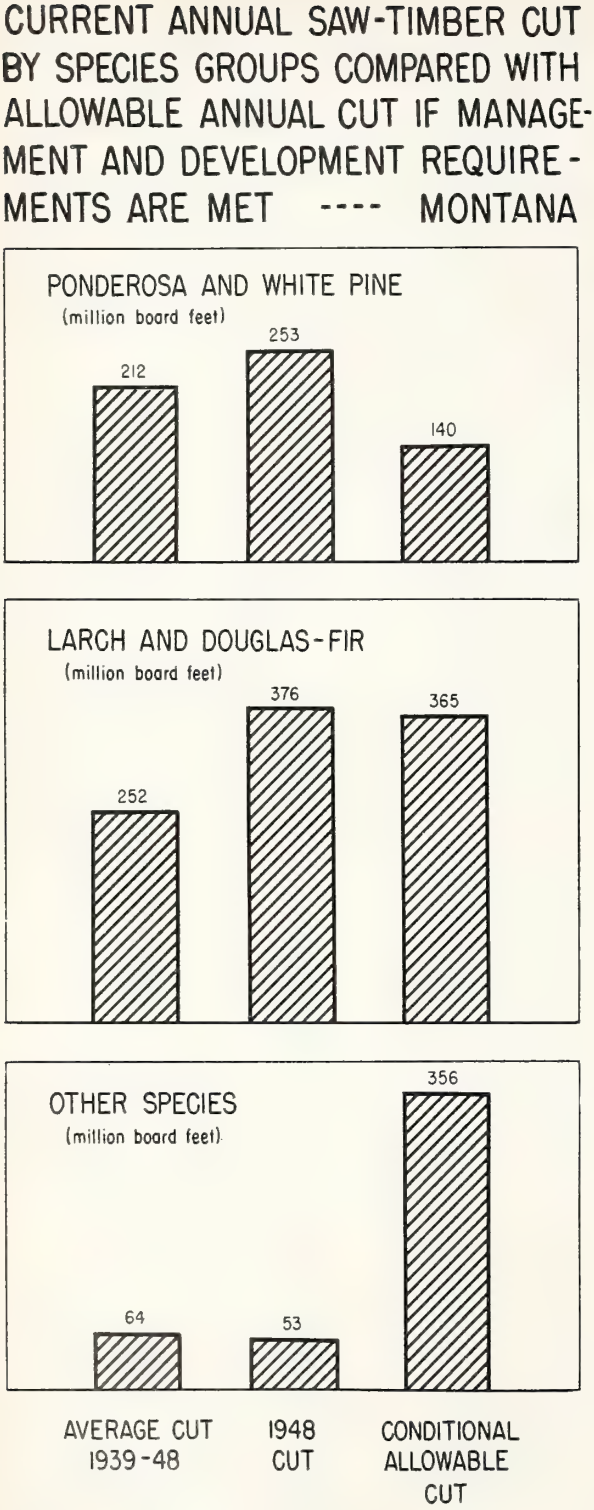

Figure 31.

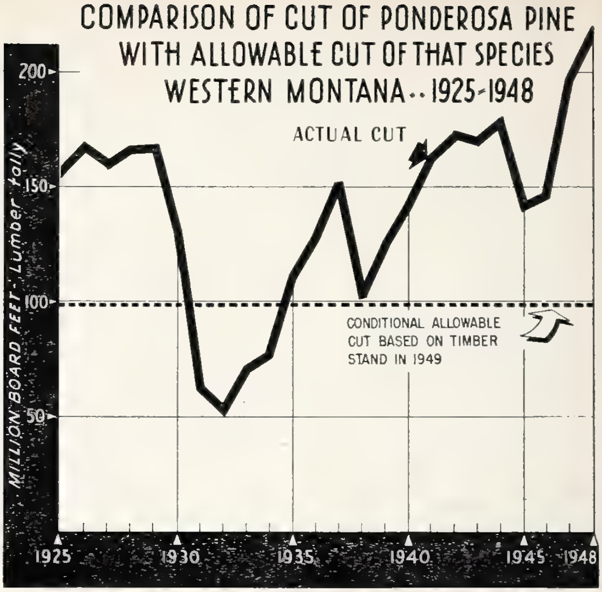

Figure 32.

extent by the uncut surpluses east of the Divide, that fact does not solve the problem in western Montana.

In several localities the overcutting of ponderosa pine has been especially severe. In Ravalli County, for example, the cut during the decade 1936 to 1945 was almost three times higher than the allowable cut (fig. 33). The inevitable result will be drastically curtailed production of ponderosa pine for a long time.

Only a few general statistics by ownership are available. They are presented in table 1, which shows that the conditional allowable cut of saw timber on the national forests is in all instances higher than the present cut. However, the national-forest cut of ponderosa pine and western white pine in western Montana is about as high as it should go, and the larch and Douglas-fir cut is also approaching the ceiling. There is considerable room for expanding the cut of other species. On the national forests of eastern Montana, the present cut of saw timber of all species is only a fraction of the conditional allowable cut.

The situation of the other ownerships is different. In eastern Montana the timber cut outside the national forests could be doubled. But, in western Montana the ponderosa pine,[12] larch, and Douglas-

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[12] The volume of western white pine outside the national forests is too small to permit an accurate over-all comparison of actual and allowable cut.

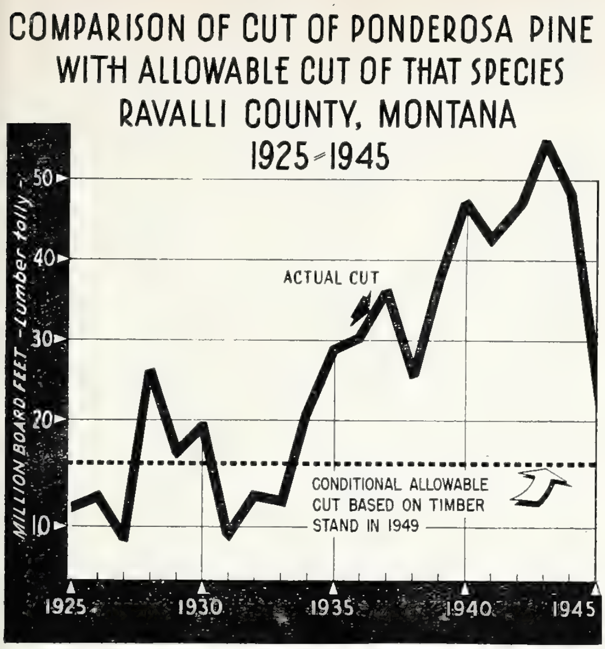

Figure 33.

fir timber not in the national forests is being heavily overcut. The drain on ponderosa pine is three times as high as it should be. Table 1, of course, reflects only the over-all situation of all other ownerships combined. In some localities and on some of these holdings the rate of cutting is quite satisfactory. On others the unbalance is therefore that much more marked.

Though privately owned timber in western Montana is in general being cut much too rapidly, the heaviest overcutting during the period 1940–49 occurred on State-owned lands.

Industrial Expansion Opportunities

Montana's commercial forests provide work for about 5,800 persons in logging camps, sawmills, and other timber-product industries. This is at the rate of one worker for every 2,700 acres of commercial forest, which is very much different from the national average of roughly one worker for every 300 acres. It seems unlikely that forest industries in Montana can be built up to the point where there will be one worker for every 300 acres. However, the allowable cut figures make it plain that there is considerable room for increasing both the income and employment from forest-products industries. On the other hand, these figures make it plain also that indiscriminate industrial development would do more harm than good. It is essential for the development to be fitted to the resource so as to make the most of the timber surpluses and not to aggravate the shortages.

Table 1.—*Montana saw-timber cut in 1948, by two major ownership groups, compared with conditional allowable cut*

Ownership class	Western Montana		Eastern Montana	
	1948 cut	Conditional allowable cut	1948 cut	Conditional allowable cut
	Million board feet	*Million board feet*	*Million board feet*	*Million board feet*
National forest:				
Ponderosa and western white pine	47	48	2	10
Larch and Douglas-fir	116	144	9	62
Other species	14	127	15	180
Total	177	319	26	252
All other:				
Ponderosa and western white pine	198	69	6	13
Larch and Douglas-fir	241	136	10	23
Other species	16	36	8	13
Total	455	241	24	49
Total, all owners	632	560	50	301

Three broad lines of action will meet that requirement: (1) Developing new industries with different raw material needs; (2) modifying the wood consumption habits of the lumber industry; and (3) making more effective use of the wood cut.

Developing New Industries with Different Wood Requirements

A major shortcoming of the timber industries in Montana today is the lack of diversification in manufacturing. Eight-tenths of all the timber cut goes to the sawmills. And if fuel wood is excluded, nine-tenths of the timber cut goes to sawmills. There is nothing wrong with the fact that sawmills predominate, but the fact that they have been obliged to be selective so far as raw material is concerned has created much of the present difficulty.

The most obvious solution to the Montana problem is a great expansion of pulpwood production in the State, because pulp mills can utilize species of timber and small trees not suited for lumber. It has long been felt that much Montana timber will be a drug on the market until such time as there is greater use of it for fiber.

Although 53,000 cords of pulpwood were shipped out of the State to Wisconsin and Washington in 1949, that volume was but a small fraction of what the forest can supply. The total annual allowable cut of saw timber, pole, cull, and dead trees to a 4-inch top in Montana is 1,786,000 cords greater than the average cut of wood for *all purposes* during the decade 1939 to 1948 and 1,386,000 cords greater than the 1948 cut. An annual cut of 130,000 cords of wood is sufficient to support one 200-ton sulfate pulp mill. Opposing these favorable resource figures are the economic realities which have so far prevented any pulp mill from being established in the State. Along with some of the other Rocky Mountain States and Alaska, Montana is farthest away from the large consuming centers. The rising shipments of pulpwood eastward suggest, however, that the prospects are brighter than they were for large-scale pulpwood production in Montana if not for a local pulp and paper industry.

Modifying the Wood Consumption Habits of the Lumber Industry

Obviously the lumber industry cannot continue to overcut ponderosa pine timber without sooner or later exhausting the supply. Since ponderosa pine is valuable, it is highly desirable that this species always constitute a substantial part of the lumber production. The answer, of course, is to shift part of the burden of lumber production from ponderosa pine to other species. Unfortunately, the rising production of other species in recent years has not lightened the pressure on ponderosa pine.

Despite the fact that spiraling lumber prices since World War II have brought into use many of the less valuable species, there is still need for greater use of these species by the lumber industry. This is especially apparent in eastern Montana where 1948 sawmill output was only 17 percent of the allowable timber cut.

Part of the solution to the problem of the less valuable species is the development of greater demand for their lumber. Also, it is partly a matter of developing lumber-production methods better adapted to small and less valuable timber. The lumber industry in the Northern Rocky Mountains was established mainly to manufacture ponderosa and white pine lumber, and production methods were designed to handle old-growth timber of these species. The same methods are not suited for such species as lodgepole pine where quality sawing is secondary to a high rate of output. The matter of fast and efficient handling of small logs has received considerable attention in the past few years. Swedish gang saws designed to meet this need, have been installed in several Montana mills, and new types of sawmills are being experimented with in various parts of the country (*11*).

More Effective Use of Wood Cut

It is possible to enlarge the employment and income from the forest products industries 50 to 100 percent without increasing the cut itself by one stick. Though the large sawmills of the region are among the most efficient in the United States, and though considerable progress has been made in wood utilization in recent years, the forest industries still fall short of making the most of the logs they cut. Studies show that when lumber alone is sawed from the average ponderosa pine log and no byproducts are made, one-third of the usable wood is wasted in slabs, sawdust, edgings, and trims.

One notable step in the direction of more effective use is the manufacture of briquetted fuel from wood waste. Toy stock, molding, etc., are made from scrap lumber at several mills. Low grades of lumber, hard to sell in normal times, are being made into grain doors. A pilot plant has recently been built to test the feasibility of making building board out of the shavings from the lathes used to peel utility poles.

The feasibility of molasses production from sawdust and mill scraps has been carefully investigated with very encouraging results.[13] Nearly 200 tons of suitable wood waste are produced daily in the State at locations convenient to main-line transportation. Some of this material is used sporadically; most of it serves no useful purpose.

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[13] The process of chemical reduction of wood to make molasses is available for commercial use. Feeding tests have demonstrated that wood molasses provides a satisfactory substitute for cane molasses as a livestock food.

Montana lacks sufficient supplemental feed to meet the needs of her livestock industry. Some 225,000 gallons of sugarcane molasses are brought into the State each year, but livestock people estimate that molasses consumption might increase to one million gallons if a cheaper and more reliable source of supply is developed.

It is estimated that the potential feedlot market for molasses in Montana could be met with the processing of 15 tons of wood waste daily. If wood molasses is used extensively for range feeding of cattle and sheep sometime in the future, however, the Montana market for the molasses would rise far above one million gallons yearly, possibly to the point where the demand could not be met by processing even 200 tons of wood waste daily.

The sawmill industry is giving more attention to the matter of remanufacturing and byproducts. Some mills have enlarged their operations by selling less of their output as lumber and diverting part of it to making boxes, window frames, etc. The remanufacturing process in some instances more than doubles employment. For example, lumber gives 18.4 man-hours of employment per thousand board feet of production; boxes and shook, 29.9 hours; window frames and sash, 42.4 hours. All three figures include the labor from tree to finished product.

One of many other products that can be made is laminated wood. The war-time difficulty of obtaining wood of the large size and high quality necessary for bridge stringers, mine guides, ship keels, and several other purposes, the advance in glues and gluing techniques, and the opportunity for tailoring the product for a specific use, brought laminated wood into the industrial picture. With the decline in quantity of large, high-quality virgin timber, the demand for laminated stock is gradually increasing. Advances in glues and gluing techniques also open new possibilities for edge-gluing narrow boards together to make wide ones to meet customer specifications.

There is some possibility of making panel sheathing from lumber to compete with composition wallboard. Much of the lumber shipped from Montana is later cut up to remove the knots and defects in order to produce clear, small pieces. It might be profitable to do the cut-up work before shipment to avoid the freight charges on material later discarded.

Plywood mills, though they compete with sawmills for high-grade logs, are another means of making effective use of timber. By peeling or slicing a log rather than sawing it, a high-value product can be made with less waste. Thus, to the extent that plywood mills can be operated without unduly encroaching upon the lumber industry, they will be a worth-while addition to the industrial picture.

The Timber Management Task

MONTANA'S commercial forest is adding wood at an annual rate of 38 board feet per acre.[14] As already pointed out, this net-growth rate is not at present a limiting factor in the timber cut because there is an excess of mature timber. It is significant, however, because it is an unsatisfactory yield in terms of the capacity of the forest to produce. In the long run, as the older stands are cut over, the growth rate can be greatly increased. A realistic goal is an annual growth of 85 board feet per acre, but to reach it involves considerably more than liquidating old stands. It will require both reduction of present heavy timber losses and conversion of the forest to a condition where it can produce maximum growth.

Reduction of Losses

In 35 years, 1910–44, mortality in Montana's forests amounted to 25.6 billion board feet. Half of that loss was caused by insects, one-fourth by fires, and the rest by diseases, windthrow, suppression, etc. The loss in those 35 years exceeded the cut by 26 percent. Even more startling is the fact that for every 100 board feet of saw timber added to the commercial forest by growth, 88 board feet died.

Insects

While some losses have been caused by defoliators that apparently work upon trees of all ages and vigor, the principal infestations of the past half century have been by mountain pine beetles that attack ripe timber. An outbreak of this beetle was reported on Flathead National Forest in 1909. During the following years the epidemic swept southward, causing havoc in timber stands until 1933 when it subsided. As the result, insect losses from 1910 to 1944, inclusive, mounted to 12.8 billion board feet. Most of the timber killed was lodgepole pine, but much ponderosa pine was also lost.

In those areas heaviest hit by insect epidemics, the effect was catastrophic. For example, the beetles killed 85 percent of the mature lodgepole pine in Ravalli County, causing destruction which in places was almost as complete as if those areas had been swept by fire. It is estimated that 25 percent of the ponderosa pine saw timber in that county was also killed. Although the lodgepole pine thus lost had no high commercial value, the resulting jungles of fallen trees have been a fire hazard and have rendered some areas unsuitable for grazing. Even more serious, from the standpoint of commercial value is the loss of the large volume of ponderosa pine.

In addition to the losses caused by the mountain pine beetle, many other insects have been responsible for a constant, heavy drain on all timber species. While these losses are not as spectacular as the epidemic ones, they are widespread and have already killed many million feet of timber.

Figure 34 shows the trend of insect losses in Montana for four decades. During the period 1921–30, bug-infested timber was dying at the rate of 500 million board feet a year. During the period 1941–44, the annual mortality declined to 200 million board feet, but the rate of loss is believed to have risen since then. Unlike fire losses, the downward trend of damages by insects after 1931 was in no way the result of man's efforts. It was due to the natural cycle of insect attacks. Up to July 1, 1950, a total of only $570,000 had been spent to combat insects in Montana. Twice that amount is spent for fire control in a single year.

Timber stands are not static. If man does not

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[14] The growth and drain comparisons in this section are mainly confined to saw timber to avoid confusion. However, the story is in general the same for all timber. Growth and drain data for both saw timber and all timber are in the appendix tables, p. 63.

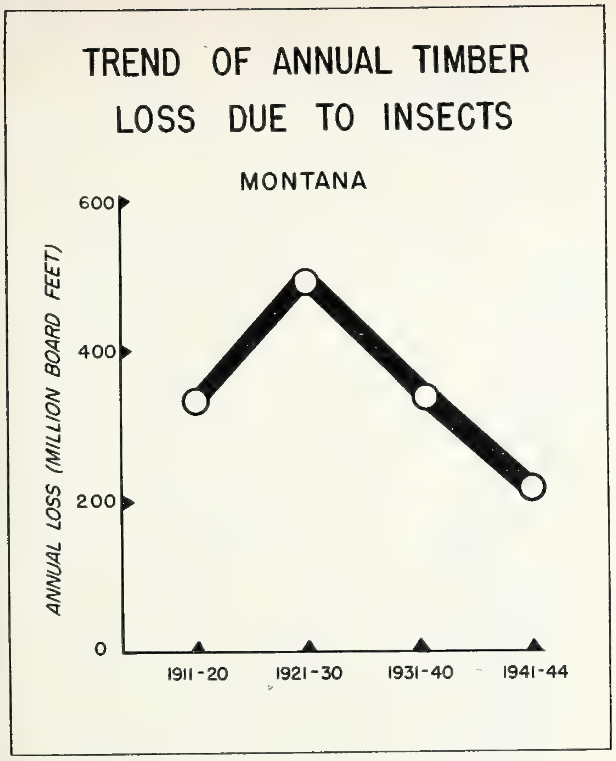

FIGURE 34.

harvest them when they are ripe, insects and disease will. That the infestation of mountain pine beetles reached the great magnitude it did from 1909 to 1933 seems to have been because a large part of the Montana timber was overmature.

As the mature forest is harvested it will be replaced by more vigorous stands, and losses due to insects will probably diminish. However, under a program of sustained-yield management, many years will be needed to complete the harvest of the mature timber, and insects may do a great deal of damage in the meantime unless steps are taken to control them.

Fire

Old-timers will recall the conflagrations of 1910, the blackest year on record for the timber of the Northern Rocky Mountains. In Montana alone the great uncontrolled fires of that year killed 2.6 billion board feet—about three times as much as the gross annual saw-timber growth. Though losses in a single year have never again reached such a peak, they have often been high.

Montana's forests burn easily. In the latter part of the nineteenth century some prospectors took advantage of that fact and set fires to clear the ground to make prospecting easier. The great conflagrations of 1910 made it plain, however, that even without the assistance of incendiarists, fires were a major menace and a big job of controlling them lay ahead if there was to be much timber available for cutting in the future. The effort to blanket the public and private forest land of Montana with adequate fire protection started shortly after the beginning of the present century. At that time several fire protection associations were formed by private landowners, and these, plus the fire-fighting organizations of public agencies, provided some protection for most of the forest land.

The dramatic story of a successful battle against great odds is seen in figure 35.[15] This record looks even better when considered in light of the declining purchasing power of the dollar, labor shortages, and other troubles which have plagued fire control agencies in recent years.

There is no doubt that the downward trend of fire losses is in large part the result of a constantly better job of fire control. Speed of attack, for example, is an essential element in control. The average time between the start of a fire and the arrival of the first men has steadily diminished. Lookouts, air patrols, a network of protection roads, and more recently smokejumpers who are flown by plane to many fires, have made possible this reduction in elapsed time.

Fire control men caution against complacency, pointing out that the decade 1940–49 was more favorable than usual from the standpoint of burning conditions. The task of maintaining a good record in the face of rising costs and manpower shortages is a difficult one.

Diseases

Of all the diseases eating away at the timber in Montana one has by its virulence pushed into the limelight. This is the blister rust of western white pine, which if uncontrolled can destroy young

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[15] Statistics for areas burned during the early years are not available for all private and public forest land. However, the data presented here for the national forests show the general trend. They include the burned area on all lands within the national-forest boundaries. The Forest Service is responsible for fire protection on an additional area outside national-forest boundaries.

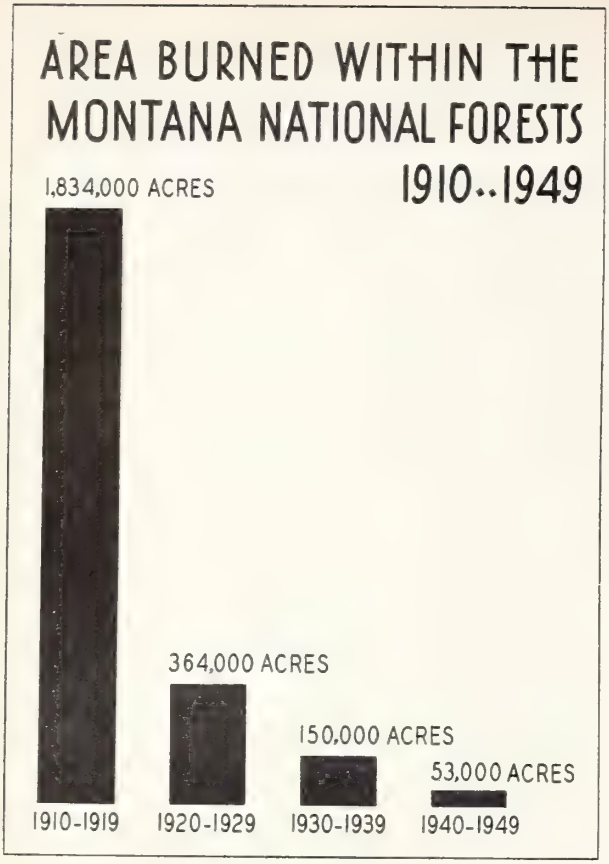

FIGURE 35.

stands in a matter of a few years and eventually eliminate this highly prized species. Though only 2 percent of the commercial forest is western white pine type, this species because of its high value is many times more important than the proportion would indicate. For that reason, a battle to control the disease in western Montana has been under way since the early 1920's, and a study published in 1948 affirmed the desirability of continuing the fight against this disease (*6*). Up to July 1, 1950, approximately 2½ million dollars was spent in Montana for control work. Currently 63,000 acres of white pine land in western Montana is under protection from blister rust. This is about 40 percent of the area that should be protected.

There are other diseases and parasites of economic importance. Among them are several wood rots. Three different species of dwarf mistletoe impair the quality of western Montana Douglas-fir, cause the top-dying of larch, and deform and kill lodgepole pine. A stem canker culls many lodgepole pine trees for poles, and a needle blight impairs the quality of some Douglas-fir stands for Christmas trees.

Other Losses

In 1948 much timber was laid flat by a big wind on the Beaverhead National Forest. In the fall of 1949, a 100-mile-an-hour wind leveled a number of stands of timber elsewhere. This blow and two less spectacular ones in the spring of 1950 knocked down approximately 200 million board feet of saw timber on the Kootenai and Flathead National Forests alone. Damage of this sort has been occurring at irregular intervals throughout the history of the stands.

As timber grows and individual trees require more room, stands are thinned out by crowding and shading. Since only the suppressed trees are affected, this loss is not spectacular. It is however, an important part of the mortality. Snow, ice, and winterkill occasionally cause loss—sometimes spectacular. In a few instances timber on entire drainages has been killed by adverse winter weather.

Present Mortality

Although progress has been made in protecting Montana's forests from fire and insect losses are lower (1951) than in some past years, it is disturbing to realize that a substantial part of the gross timber growth is still being lost. In 1949, gross annual growth for all timber amounted to 291 million cubic feet; 50 million cubic feet, or 17 percent of this growth, was nullified by mortality. Twenty-nine percent of the saw-timber growth was nullified by mortality (fig. 36). The timber mortality is not a complete loss in that some use is made of dead wood. However, the annual loss of timber is six times greater than the annual cut of dead timber.

A More Complete Protection Program

The first order of protection in Montana's forests was to curb fire. Thinking and attitudes about forest fires in this region have gone through a long evolutionary process. For a time the question was argued of whether or not fires on remote noncommercial land should be fought. Experience has given the answer. Now it is generally agreed that the soundest policy is rapid control of every fire no

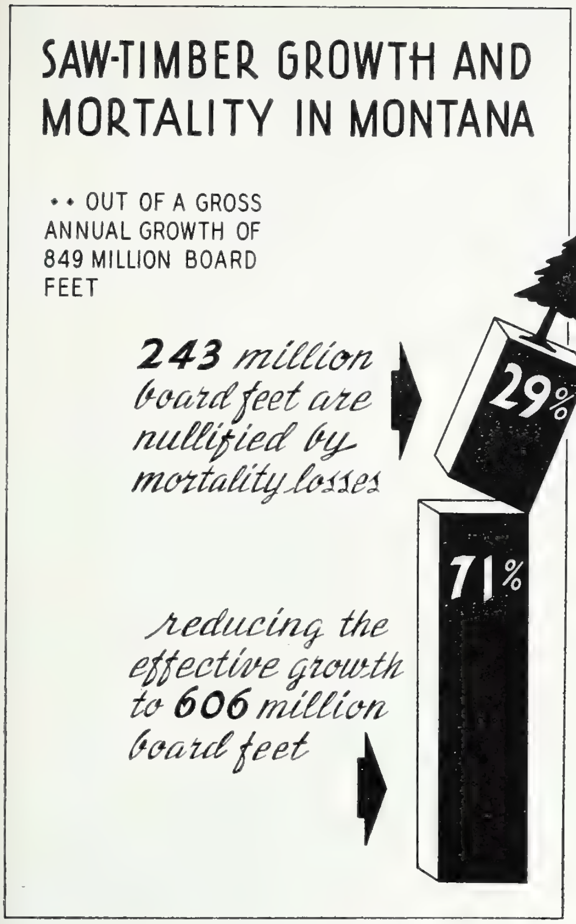

FIGURE 36.

matter where it occurs. With that policy clearly defined, the effort has been directed toward carrying it out and the problem is being tackled aggressively.

During the 1930's an all-out effort was begun to suppress blister rust. The lack of an equally forceful attack on the other enemies of the forest, particularly the mountain pine beetle, has been the principal weakness in the protection program. Reduction of losses from the present level requires a well-rounded attack.

Postponing the mortality of mature trees by controlling insect attacks is profitable only to the extent that the timber saved can be utilized before a recurrent infestation. For example, if mountain pine beetle control is to pay, the control should be followed by utilization of the susceptible trees. In the past it has seldom been practicable to obtain prompt utilization, because lodgepole pine and several other species have had only a limited market. Thus, the matter of increasing industrial development to secure complete utilization is of primary importance in managing Montana's forests.

Increasing Gross Growth

If it were possible to eliminate mortality losses, the net annual saw-timber growth in Montana would rise from 38 board feet an acre to 54 board feet. Even then, however, the net growth would be below the desired rate. If the net annual growth of the average acre is to be raised from 38 board feet to 85 board feet, gross growth will have to be increased at the same time losses are being reduced.

Merely to say that the gross forest growth in Montana should be increased gives no idea of the dimensions or complexity of the task ahead. To increase the gross forest growth involves all of the things a forester generally includes in the term "silviculture." Some forest lands are so overcrowded that the trees have stagnated. Other areas are understocked. Some are deforested. Many trees have passed their prime and are growing slowly. There are too many of some sizes of trees and too few of others. Less desirable species are gaining ascendency over preferred species. A major part of some of the older stands is cull trees that contribute nothing in the way of growth but compete for space with normal trees. The task of forest managers, therefore, is to correct these deficiencies with the objective of developing a fully productive, vigorous, fast-growing forest.

The larger problems of management arise from the advanced age of much of the timber. In western Montana, for example, stands on 45 percent of the commercial forest are over 120 years old. Many of the trees in these stands, in addition to being poor risks, are growing very slowly. Yet they should not all be cut at one time or there will be a shortage of large timber while younger stands are growing to maturity. The conflicting objectives of spreading the old timber for a sustained yield and cutting it before it dies require a calculating eye on each tree to determine its life expectancy.

Hand-in-hand with the problem of managing these old stands for a sustained-yield cut to offset the shortage of intermediate-age timber in the next few decades, is the one of securing ample reproduction of the desired species (fig. 37). Studies in the ponderosa pine type, for example, show that this species reproduces best in stands of 3,500 to 5,500

FIGURE 37.—*A, A stand of dead and decadent ponderosa pine saw timber amply stocked with the wrong species of reproduction (Douglas-fir). B, In this stand there is a minimum of decadent timber, a good distribution of age classes, and ponderosa pine is succeeding itself. The long-run silvicultural problem is to convert the ponderosa pine area in western Montana to the condition shown here.*

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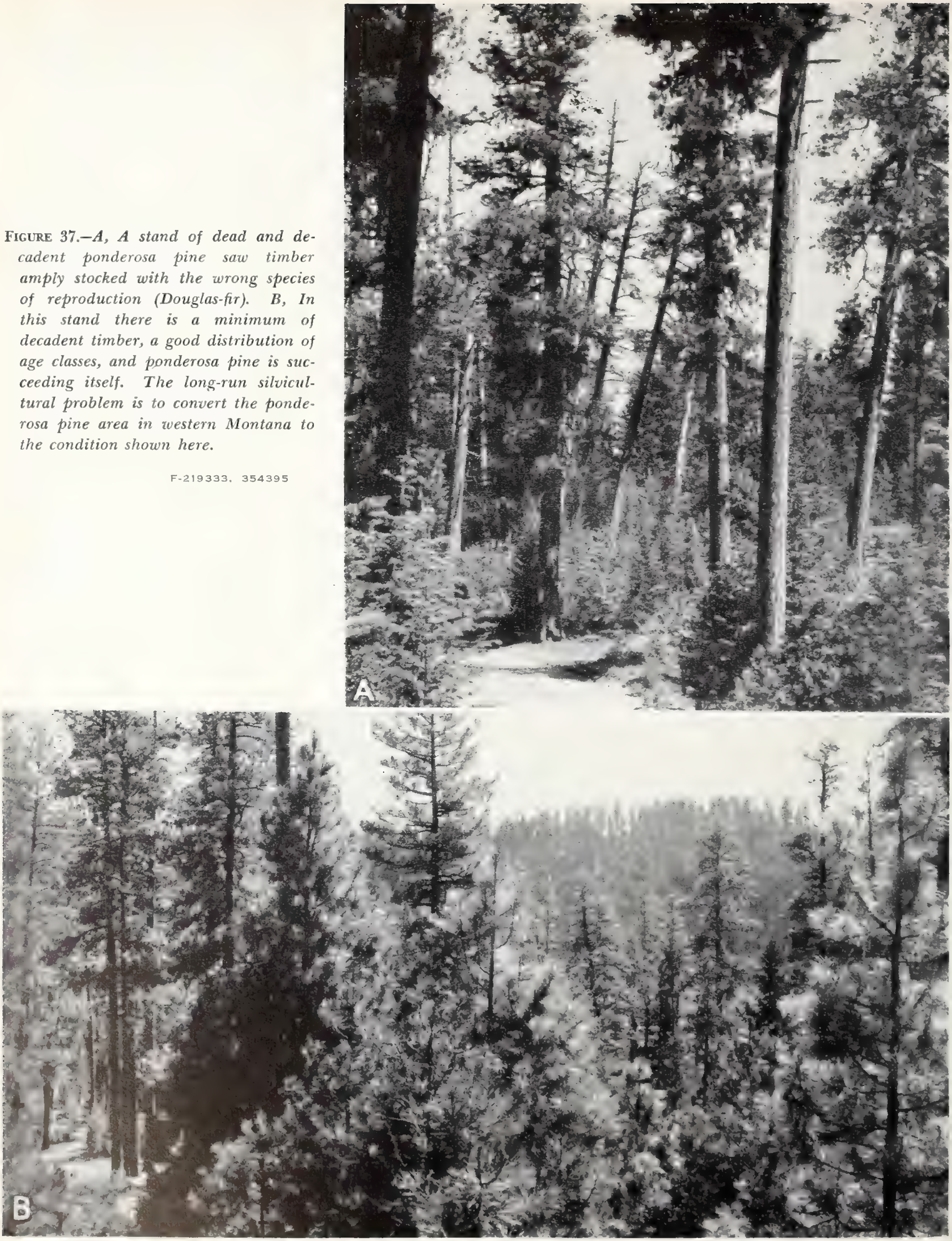

board feet an acre, but that much higher saw-timber yields in the coming few decades can be obtained by leaving a greater volume per acre.[16] To further complicate matters, silvicultural methods must be designed to prevent Douglas-fir from taking over ponderosa pine and larch stands, grand fir from encroaching on western white pine, alpine fir on spruce, etc.

Overcrowding of trees is a common failing of Montana's coniferous forest. Because of this tendency, many stands become stagnant, and growth is held down. Thinning is the most elementary type of management for such stands, yet little of it has been done. More needs to be done. However, if a large-scale thinning operation is to be successful, markets must be found for the small trees cut in the process. Even with a large part of the cost repaid by immediate returns, some of the thinning will be in the nature of a long-time capital investment.

In contrast with the generally good stocking of the forest, there are a few denuded areas that have restocked only partially or not at all. One-half million acres of commercial forest in Montana are deforested, that is, they are less than 10 percent stocked with trees. Planting of some this area is desirable. So, also, is interplanting of some understocked stands. Any considerable expansion in the planting program will require the development of more nursery facilities.

To the complexities involved in stepping up the growth rate may be added the difficulty of adequately dispersing timber operations. Most forest stands in Montana have some trees that should be cut and others that should be left to grow. The timber ready for harvest, therefore, is widely scattered. In contrast, utilization has been unduly concentrated. Vigorous timber in accessible areas has been logged, while more remote timber ready for harvest has been going to waste.

The Montana situation is a prime example of the need for close correlation between the silvicultural and utilization phases of management. The industrial possibilities discussed in an earlier section will not be realized unless protection and other management measures are so intensified that gross growth is increased and mortality reduced. On the other hand, more complete and better distributed industrial use of the timber is required if the objectives discussed in this section are to be fully effective. Cutting of trees is in reality just as much a part of management as planting and insect control.

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[16] ROE, ARTHUR L. GROWTH OF SELECTIVELY CUT PONDEROSA PINE STANDS IN THE UPPER COLUMBIA BASIN. U. S. Dept. Agr. Handb. 39, 1952.

A Development and Management Program

ALTHOUGH it is reasonable to look forward to continued progress in forestry and forest utilization in Montana, we must remember that even after a half century of effort we have accomplished only part of the tremendous job of putting 15.8 million acres of commercial forest to sustained use. After half a century, industries are still using only part of the timber available to them. Trees that Nature took a century or more to grow are still dying and falling to the ground unused (fig. 38). Much more needs to be done to convert the forest to a well-managed, fast-growing one. There is need for an adequate program for opening up the forest so that it can be used and managed, and for all owners to exert more effort toward improving and increasing timber yields.

More Roads Are Needed

Timber cannot be used unless there are roads over which it can be taken out. We are reminded of this almost every time the necessity arises for salvaging trees damaged by a bad fire, insect attack, or blowdown (fig. 39). The amount of loss from such catastrophies depends upon how much of the damaged timber can be salvaged. However, salvage is only one aspect of the transportation problem. Without a well-developed road system, full and balanced industrial expansion is impossible. Without adequate roads, the management objectives discussed earlier are quite academic.

The existing road system is not adequate. In the national forests, for example, the basic skeletal network[27] required for proper administration is estimated to be 12,300 miles. In 1950, only 6,900 miles of that road were in existence. Although the entire 6,900 miles are good enough to serve the purposes for which they were constructed, only 1,600 miles are of sufficiently high standard to carry all of the traffic that would come with full utilization of the forest resource. A large proportion of the present road system was built for fire control purposes at a time when it was necessary to get maximum mileage for the limited funds available. This, in many instances, accounts for the inadequacy of such roads for other purposes. The 5,300 miles of existing road which need to be rebuilt or replaced and 5,400 miles of entirely new road which need to be constructed would cost over 125 million dollars.

During the decade 1939–48 approximately 7 million dollars was spent by the Government on the construction of a basic-road system within the boundaries of Montana national forests. At that rate, it would take 150 years or more to complete the job. Although not all of the roads are needed immediately, the major part of the basic-road network should be completed in the next 20 years. Obviously, the longer the delay in completing the network the longer industrial and forest development will be retarded and timber wasted.

Intensifying Public Land Management

In Montana 76 percent of the forest land is managed by State and Federal agencies. Thus, a major part of the responsibility for future handling and development of the forest falls directly on the public. The following tabulation shows the forest landownership in Montana:

	All forest (million acres)	*Commercial forest (million acres)*
Public ownership:		
National forest	13.9	9.0
Indian Service	.7	.6
Public domain	.7	.6
National Park and other Federal	1.0	
State	.7	.6
County and municipal	.1	.1
Total	17.1	10.9
Private ownership	5.3	4.9
All ownerships	22.4	15.8

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[27] This is best described as the main arterial system from which logging, mining, and other local roads branch. It is only a fraction of the total road mileage required on the Montana national forests.

F-464663

Figure 38.—*A 20-inch, four-log ponderosa pine killed by insects. The death of this pine nullified one year's growth on 8 acres. Trees like this one are mute evidence that full industrial use is not yet being made of Montana's timber.*

The State of Montana is in the forest-management business because of the land grants it received from the Federal Government for financing schools and other institutions. Six million acres, mostly grassland, were thus acquired. The State at present owns 658,000 acres of forest.

The Indian Service, Department of the Interior, manages 712,000 acres of forest land actually belonging to the Indians on seven widely scattered reservations.

The National Park Service manages 933,000 acres of forest for the purpose of preserving for recreation outstanding scenic and wildlife attractions.

The Bureau of Land Management handles 700,000 acres of public domain forest left over after homesteaders had made their selections and various grants and withdrawals had been made.

Counties hold 81,000 acres of forest that they acquired through tax delinquency and by other means.

The Forest Service manages 13.9 million acres of forest land in 11 national forests, or 62 percent of the forest area of Montana.

All together public agencies manage 17 million acres of the 22.4 million acres of forest land in Montana—76 acres out of every 100. Over the United States as a whole, only 34 of every 100 acres are publicly owned or managed. It is especially significant that a major part of the forest in Montana was retained in public control to assure a higher type of management than it was expected to receive if parceled out to individuals and companies. How well has that objective been realized?

On the credit side of the ledger may be listed several important facts. Public agencies have taken the leadership in wild-land conservation. An unbroken wilderness, much of which is difficult mountain terrain, has been tamed to the point where fire losses have been greatly reduced. Satisfactory working procedures have been set up for selling timber, leasing range, and handling other business. A survey of forest management practices in 1944, made by the Forest Service in cooperation with the State Forester and other agencies, indicated that the over-all situation with regard to cutting practices on public lands was favorable.

Looking at the public lands from the standpoint of what needs to be done, it is obvious that a big job lies ahead. Cutting practices can still be improved; this is true on some types of holdings more

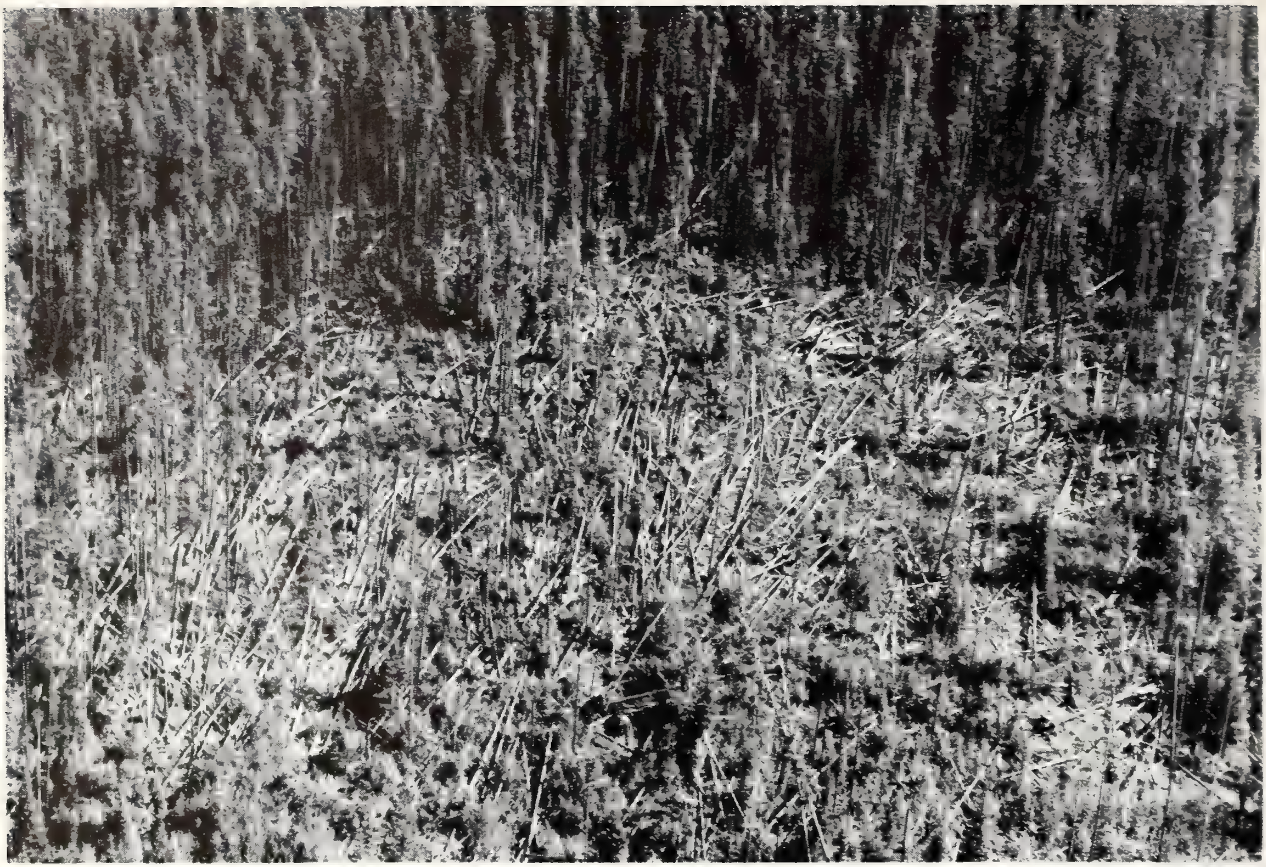

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Figure 39.—*A blowdown area on the Kootenai National Forest. Timber loss from this and other destructive forces can be kept at a minimum only if there is an adequate road network to permit salvage.*

than on others. The timber cut on public lands has climbed steadily for a number of years, but it can climb higher even though the opportunity for expansion is not uniform. As already pointed out, State-owned forest lands are being cut at a faster rate than can be sustained, the overcutting being especially heavy in ponderosa pine. The opportunity for expanding the cut is therefore on the national forests, which constitute 82 percent of the public commercial forest, but are not being cut to capacity.

For many years the job of wild-land management on national forests has been primarily a custodial one of fire control, construction and maintenance of improvements, etc. There was, in fact, during the depression years a deliberate and considered effort to withhold public timber to avoid depressing the timber market. The national forests of Montana, therefore, entered World War II with a cut of roughly 62 million board feet a year. In response to the timber needs of the war and postwar period cutting was accelerated, reaching a high of 203 million board feet in 1948. As pointed out earlier, the 1948 cut was considerably below the conditional allowable cut for the national forests.

It is apparent that the time has arrived when public forests should be more fully utilized. The increased demand for public timber since World War II and the obviously declining private supplies indicate that public forest lands in Montana must carry much more of the production load in the future than they have in the past. Also, heavy losses that occur in an undeveloped timber resource are no longer acceptable.

Public land managing agencies in Montana cannot now fully meet their responsibilities with regard to timber production, watershed protection, grazing, etc. The difficulty of proper management and utilization because of an inadequate road system has already been mentioned. While this is a paramount problem, it is not the only one. There is need for a substantial capital investment in these lands. Some of that necessary capital investment should be used for buildings, fences, and other physical improvements; some for planting, stand improvement, erosion check dams, etc.; and some for the acquisition of land uneconomic for private ownership.

Although, protection, road building, and other similar activities on public forest land need to be accelerated, the scale of these activities is much closer to the ultimately desired level than are the actual timber-growing phases. There are the equivalent of about 42 full-time foresters engaged in timber-management activities on Montana national forests. This means that each forester has the responsibility for the timber-management work on 200,000 acres.

Experience in the South indicates that it is profitable to employ one forester for 5,000 to 25,000 acres of commercial forest. That intensity of timber management is not considered feasible in Montana because of the lower growth potential and other factors. Nevertheless, the effort put into timber growing on Montana national forests should be very much greater than it is. This is also true of State forests and other publicly managed lands.

Intensifying Private Land Management

Only one-fourth of Montana's forest area is privately owned, but when proper account is taken of quality, private holdings are more important that this percentage indicates. Almost one-third of the commercial forest land, and an even larger percentage of the most accessible and productive land, is privately owned. The many properties that make up the private forest vary in size from a few acres to hundreds of thousands of acres. Four companies, each with holdings of 150,000 acres or more of commercial forest land, own about 55 percent of the private forest in western Montana.

Large private owners contribute to the overcutting of saw timber in western Montana. They therefore have a major responsibility along with the State and small private owners to bring the cut, particularly of ponderosa pine, down to a level that can be sustained. While there is some excellent forest management on large private holdings, the over-all management record of these owners is still not satisfactory in that the requirements for sustained yield at a high level are not being met. One of the bright spots in the Montana forestry situation today, however, is the very encouraging signs of progress so far as large private-forest management is concerned. In 1949 the four large owners had 832,000 acres certified as tree farms.[18] This is significant as evidence that these owners intend to practice good forestry on part of their holdings.

The small private-forest holdings in Montana differ from the large holdings in two main respects: (1) They are more accessible and closer to the valley floor, and (2) they have been more heavily used. Figures to illustrate the latter point are available only for western Montana. Approximately 23 percent of the small private-forest area in that part of the State contains saw-timber stands. Almost 60 percent of the large private area bears saw-timber stands. It should be borne in mind that these figures in no way indicate the rate of cutting. Many acres cut over by the large companies were later sold to small owners, primarily for grazing purposes.

As in many other sections of the United States, the most critical and perplexing part of the forest situation involves the small private owner (*19*). There has been relatively little good forestry on small timber holdings in Montana and few signs of improvement. For example, only 35 of them were classified as tree farms at the end of 1949. This is less than 1 percent of the number of small forest properties.

Several factors contribute to the poor showing of the small private owner. No doubt the most important one is the time element, that is, the long waiting period involved in growing trees, which contributes to a lack of financial incentive. Very often the small owner's pressing need for money tempts him to skim off all of the value and forget about the future. Unfortunately, in most instances properly managed young stands have no greater market value than poorly managed stands at the present time.

Good management in this region is further handicapped by economic problems already discussed, which make it impractical to fully utilize the timber. Then, also, many small properties not connected with farms suffer the handicap of size. They are too small to be anything but a side line, and as such they are neglected.

The absence of notable progress or hopeful signs on small private holdings makes it plain that such landowners should receive more attention than they have been getting. Public agencies and the tree-farm movement have so far made small gains in this field.

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[18] The tree-farm movement, sponsored by the Western Pine Association in this region, came into Montana in 1947. It is effort by industry to improve forest practices in the United States. Tree farms have been described as follows (*3*): "A tree farm is generally defined as 'an area of privately owned forest land dedicated to the growing of forest crops for commercial purposes, protected and managed for continuous production of forest products.' "

It has been said that when good forestry is profitable for the private owner he will practice good forestry. While this statement greatly oversimplifies the case, it has a large element of truth in it. Certainly, the primary stimulus to private endeavor is the opportunity for profit. The recent forestry progress among large private owners is largely due to the improved economic outlook for long-term forestry enterprises in the State. Notwithstanding, one of the handicaps that the people of Montana must face is that the margin for profitable operation is and perhaps always will be much narrower here than in most other timber-producing areas of the United States. That handicap makes it difficult for private owners to do all they should in a forestry way. Therefore, while private forest owners have an obligation to handle their lands properly, they need public help.

Public effort to encourage private forestry and make it profitable has been piecemeal and inadequate. There are several ways the public can help private owners to increase timber yields, and thus employment and income: (1) Provide education and technical on-the-ground guidance. (2) Provide other assistance such as credits. (3) Relieve burdensome conditions, such as discriminatory taxes. (4) Prevent owners from abusing their properties. (5) Manage public lands in such a way as to favor and facilitate proper management of private lands.

Improving the Ownership Pattern

To say that the ownership pattern of forest land grew in a haphazard fashion is an understatement. The net effect of the various alienations and withdrawals from the public domain was in places a scrambled ownership situation which greatly complicates forest management.

A map plotted with the original grants of land to Montana for schools and other institutions would have the appearance of being peppered by a shotgun. The organic Act of the Territory of Montana, for example, gave the State sections 16 and 36 in every township for the support of the common schools. The State was able to consolidate a few blocks when the original selections were made and there was some consolidation later through exchanges of land with the national forests. However, only one-third of the State timberland, 222,000 acres, is concentrated in seven fairly large units which have been set up as State forests.

State forest:	*Area of State-owned land within State forests (acres)*
Coal Creek	20,000
Stillwater	90,000
Swan	42,000
Thompson River	30,000
Clearwater	18,000
Lincoln	8,000
Sula	14,000
Total	222,000

The rest is scattered throughout the State in small tracts, usually of 640 acres and less. Even within the State forests, State lands are far from being in solid blocks. The Forest Lands Advisory Commission points out (*12*): "Since, however, most of the timber and land within the boundaries of the majority of these State forests are privately owned, the State forest idea is little more than a name."

The Northern Pacific Railway was given alternate sections on a strip 40 miles wide, paralleling its railroad tracks through Montana.[19] One result was a checkerboard ownership pattern that still exists in some localities (fig. 40), and creates innumerable problems of development, management, and utilization. Because a large part of the railroad land was sold to other private owners at the beginning of the century, the problem of intermeshed ownership affects more than the Forest Service and the Northern Pacific Railway.

Homesteaders could go wherever they wished on the public domain when it was opened to settlement. Many of them staked their claims in timber areas where the economic odds have been against them and where, in some cases, their holdings have impaired the administration of surrounding lands.

After the various selections, grants, and withdrawals had been made from the public domain, the Bureau of Land Management of the Department of the Interior was given the responsibility for administering the remainder. This land is widely scattered over the State. Ownership data for western Montana, collected during the middle 1930's, showed that there were 201,000 acres of unappropriated lands in that part of the State in 799 separate tracts. The average tract was 252 acres.

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[19] When the alternate sections given to the railroad were already occupied it had the privilege of selecting an equal area of land outside the strip.

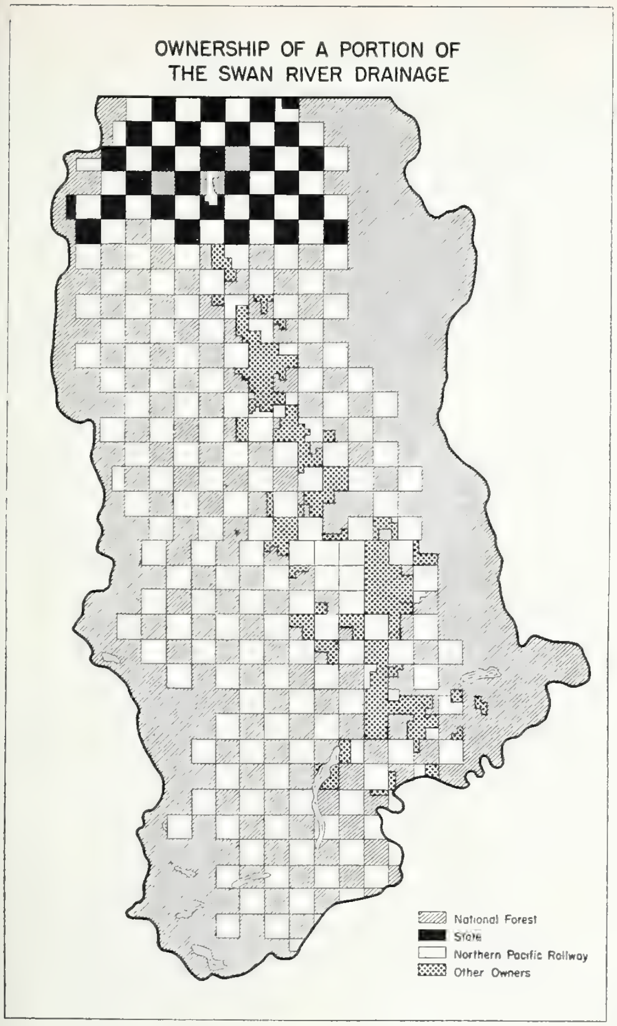

Figure 40.

Obviously, such scattered holdings represent a very difficult management problem.

East of the Continental Divide a major part of the unreserved public domain is subdivided into grazing districts handled by the Bureau of Land Management. Since many of the grazing districts are interlocked with the national forests managed by the Forest Service (fig. 41), this creates the administratively questionable situation of two Federal agencies doing virtually the same job in a single locality.

The handicap created by the ownership pattern can, to a large extent, be overcome if action along several different lines is successful. Some holdings should be consolidated to facilitate their management. There is a particular need to do this in the case of the widely scattered State-owned forest lands. A consolidation process started several decades ago was stopped by an informal ruling of the Attorney General that land exchanges for this purpose are unconstitutional (*13*). This difficulty can apparently be overcome only by submitting the matter to the vote of the people through a referendum.

The awkwardness arising from intermeshed holdings can be corrected to some extent by land exchanges between owners. Since 1947 the Northern Pacific Railway and the Forest Service have been unscrambling their holdings by this means.

Acting under authority of the Taylor Grazing Act of 1934, the President withdrew all public domain lands from location, settlement, and entry, pending classification. They can no longer be disposed of unless classified by the Department of the Interior as suitable for disposition (*15*). A way should be found to provide economical administration for parcels of public domain not reasonably consolidated. Many of them near to or adjoining major holdings of other public lands should prob-

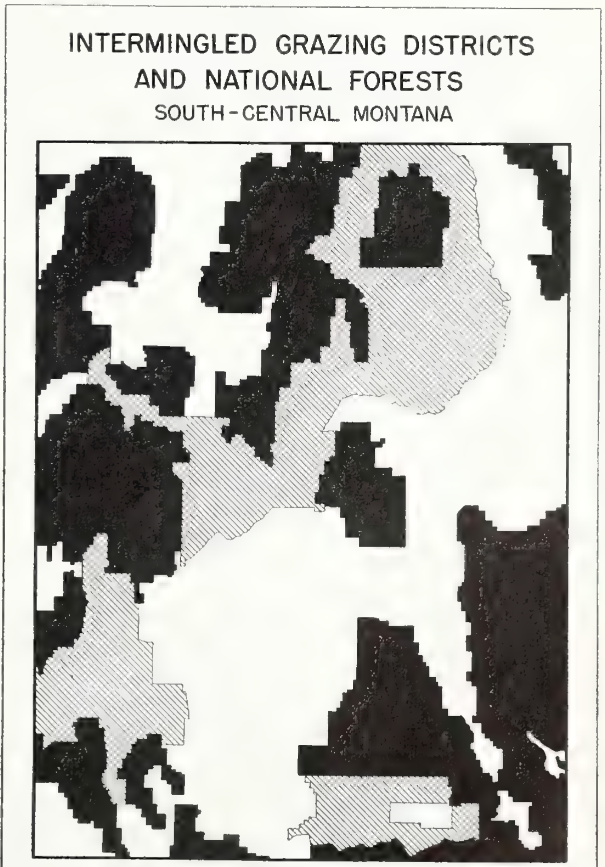

Figure 41.

ably be attached to these holdings for administration (fig. 42).

Some of the handicaps of the ownership situation can be overcome by cooperation among owners. Public agencies will find that they can often do the greatest good by managing public lands in a manner to facilitate the sound management of private lands. An outstanding example of this is the proposed cooperative sustained-yield agreement between the J. Neils Lumber Co. and the United States. In this instance the objective of pooling resources is to make sustained-yield management by the company feasible. Thus the continued operation of a highly desirable manufacturing plant for the sake of community stability is assured. Most of the national forests are located atop mountain ranges and stop short of the valley floor. Because deep snows and rough topography increase the problems and costs of seasonal logging, some of these areas can be utilized more effectively in conjunction with the more accessible lands of other owners than as independent units.

A More Productive Forest

The forests of Montana have the capacity to produce a far greater volume of wood than they are now producing. There can be no doubt of that. It is possible to nearly double the saw-timber growth. If these forests are made fully productive and are fully utilized, the cut of all timber can eventually be raised to about four times the 1948 level. At the same time, employment could be raised to an even greater degree by intensifying manufacturing.

How successful the State will be in taking advantage of the opportunity to fully utilize its forests depends upon two factors. First is the factor of economic feasibility. As discussed earlier, Montana is a marginal area from the standpoint of timber industries because of transportation costs. How much the situation will change depends to a great extent upon the future relationship of timber supply and demand for the Nation as a whole. If it continues to be fairly hard for the country to meet timber-product needs, Montana will be able to make more complete use of its timber than it would otherwise. The prospects for increased timber utilization are very favorable.

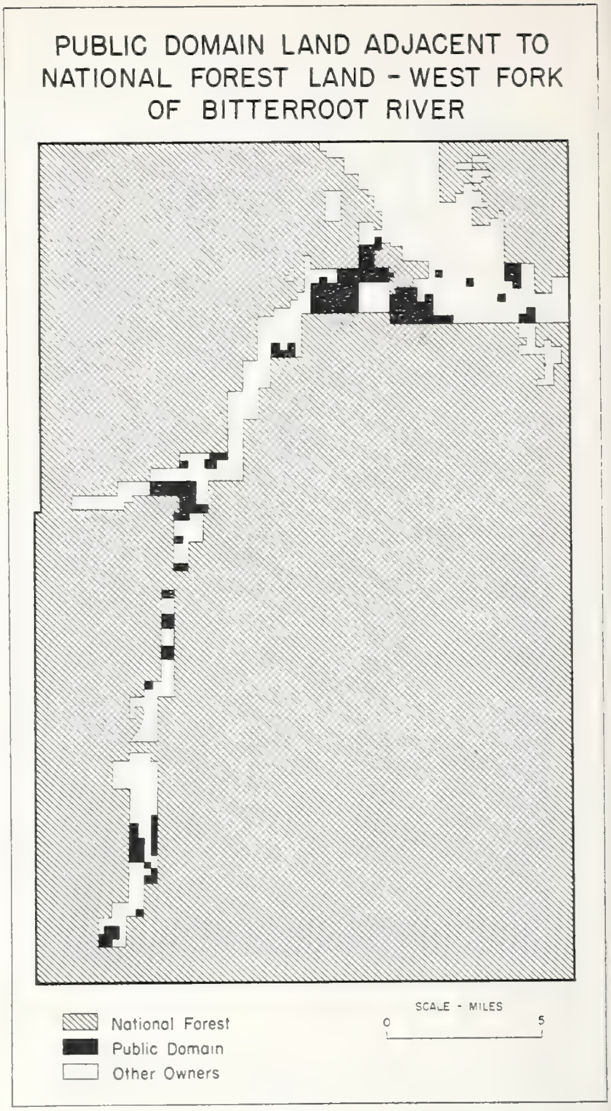
PUBLIC DOMAIN LAND ADJACENT TO NATIONAL FOREST LAND – WEST FORK OF BITTERROOT RIVER
▨ National Forest
■ Public Domain
☐ Other Owners
SCALE - MILES
0
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Figure 42.

The other factor in the future situation is how aggressively the forest protection, development, and management jobs are tackled. Handling 15.8 million acres of commercial forest land properly is an enormous undertaking. As in any large undertaking, many problems and complications are involved. These can be overcome only if private landowners, State and Federal agencies, and the public understand and agree on objectives and responsibilities, and then all do their part.

Much of the leadership should come from the people of Montana. They must decide what they want the forests to contribute to the welfare of the State. Out of that decision should grow a program for capitalizing on this golden opportunity.

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Appendix

Survey Methods

Area

Estimates of forest land were determined partly by complete survey and partly by sampling (table 2). Complete-survey technique was used for the area west of the Continental Divide, four counties east of the Divide, and other areas east of the Divide which are reserved, such as national parks. For the State as a whole, approximately 54 percent of the total area was classified as nonforest zone by reference to aerial photographs or by field reconnaissance. Twenty-seven percent was covered by complete surveys; 19 percent by sample surveys.

TABLE 2.—*Area of Montana forest land surveyed, by class of land and survey method*

Class of land	Complete survey	Sampling survey	Factored out[1]	Total
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*
Forest:				
Commercial	9,882	5,874	....	15,756
Noncommercial	2,629	1,447	....	4,076
Reserved	2,527	....	....	2,527
Total	15,038	7,321	....	22,359
Nonforest	10,230	10,828	50,225	71,283
Total, all classes	25,268	18,149	50,225	93,642

[1] The nonforest land originally was a part of the area to be sampled. It was eliminated from the survey area by means of aerial photographs and field examination to increase sampling efficiency.

For the part covered by complete survey the determination of forest area was as follows: Cover types were delineated and designated by symbols on transparent overlays fitted to the latest base maps in township units on a 2-inch-to-the-mile scale. Intensive private and public timber cruises, county land classifications, cutting records, fire records, and aerial photographs provided information for the preliminary classification of most of the area into nonforest and forest land, the forest land into 10 types as characterized by tree-species composition, and into 4 stand-size classes (saw timber, pole, seedling-sapling, and deforested). This office information was checked and adjusted in the field in connection with the mapping of the cover in areas for which such information was lacking.

All forest land was further classified in the field into commercial and noncommercial: the commercial into 3 stocking classes, 10 age classes, and 5 site classes. Black and white maps made from office tracings of the completed overlays were colored to emphasize type, commercial character, and stand-size classes. Other subclasses were differentiated by symbol only. A vellum overlay delineating 8 ownership classes was fitted to the colored base. From this combination the area of the various cover classes within each township was determined either by the use of zylonite shields lined in 10-acre subdivisions or by planimeter. The area determinations were tabulated by sections and checked against official Land Office totals for surveyed areas. For unsurveyed areas the summations were checked against the planimetered area of idealized townships as indicated on the lastest base maps.

For the area sampled, the population was classified on 1-inch-to-the-mile base maps into three sample categories: (1) parts inside national-forest boundaries, (2) parts outside national-forest boundaries for which aerial photographs were available at less than $2 per sample, and (3) parts outside national forest boundaries either not covered by aerial photographs or for which photo costs exceeded $2 per sample.

The three sample categories were further stratified into blocks of approximately 16, 49, and 100 square miles, respectively, by marking Land Office section corners (or idealized section corners in unsurveyed areas) at 4-mile intervals in class 1, 7-mile intervals in class 2, and 10-mile intervals in class 3. These marked section corners or control points were transferred to aerial index maps from which photographs were selected to give detailed coverage for a 2,560-acre segment (4 sections) centered on each control point in class 1 and for a 640-acre segment (1 section) lying northeast of each central point in classes 2 and 3. The sum total of these segments constituted the sample.

Each sample segment was examined on the ground. All forest areas of each sample segment were classified and mapped by commercial character, forest type, stand size, stocking, age, and site classes, either on a vellum overlay or directly on the photographs. In the office the area of the various cover classes within the samples was determined by dot or square counting, summarized by sample categories, and multiplied by the appropriate factor.

Volume

For the area covered by complete survey, board-foot estimates for saw-timber trees in saw-timber stands were derived from: (1) national-forest cruises, (2) other public and private cruises adjusted to a common standard by factors based on check cruises, and (3) ocular estimates made by field men while mapping cover types. Cubic-volume estimates of saw-timber trees in saw-timber stands were calculated from board-foot volumes by the use of ratios based on wood-scale studies.

The volume of pole timber in saw-timber stands was derived from mean-acre volumes by types, based on check-cruise tallies. The board- and cubic-foot volumes in stands other than saw timber were calculated from modified normal yield tables. Yield-table modifications were based on 411 1/4-acre samples measured throughout these stands at 2-mile intervals along roads and trails. All board-foot volumes, initially calculated in terms of Scribner rule, were converted to International 1/4-inch rule by means of factors derived from mill-scale studies.

For the sampled area, total volume was derived from mean-acre volumes and area by sample class, forest type, stand-size, and stocking classes. Mean volumes were based on tree tallies on 2,713 1/5-acre permanent sample plots—a cluster of 2 or 3 plots in each sample-area segment containing commercial forest land. Three-plot clusters were measured in sample class 1 and two-plot clusters in sample classes 2 and 3 (see Area discussion). Within a cluster, plots were spaced 5 chains apart, the initial plot being 2 chains in a random direction from the control point of that sample-area segment. All plot centers were staked and referenced to 2 scribed witness trees to facilitate future location and remeasurement.

Growth

For the area covered by complete survey, only net growth was determined. Stands were divided into two categories: (1) "Nongrowing stands" in which increment was assumed to be offset by mortality and for which no growth was calculated. This category consisted of all virgin stands of ponderosa pine, larch, and Douglas-fir older than 200 years, and virgin stands of all other species older than 160 years. (2) "Growing stands" in which experience indicated that increment generally exceeded mortality. This category included uncut stands of ponderosa pine, larch, and Douglas-fir up to and including 200 years, uncut stands of other species up to and including 160 years, and partially cut stands of all types regardless of age. Average net growth per acre by type, stand size, age, stocking, and site classes was derived from modified normal growth tables. Modification of normal tables was based on actual net growth as determined from increment borings and mortality tallies on 375 1/5-acre sample plots covering the range of age, stocking, and site classes within types.

Gross and net growth for the area sampled were derived from increment borings of sample trees and mortality tallies on each sample plot measured for inventory purposes (see discussion of Mortality). Size of the sample measured for growth varied from 1/500 acre for trees 5.0 to 10.9 inches d.b.h., 1/50 acre for trees 11.0 to 24.9 inches d.b.h., to 1/5 acre for trees 25.0 inches d.b.h. and larger. Radial growth was determined for the 10-year period preceding the date of field examination. Radial growth was converted to volume growth by subtracting the reconstructed volume of sample trees 10 years ago, taking into account changes in height and bark thickness as well as diameter, from current sample-tree volume.

Sample trees were divided into two classes: (1) ingrowth trees, those that either developed from sapling into pole size or grew out of pole size into saw-timber size, and (2) main-growth trees, those that remained either of pole size or of saw-timber size during the growth-study decade. Total ingrowth was derived by multiplying the mean ingrowth per acre by the appropriate area by type, stand-size, and stocking class. Total main growth was calculated from simple growth percents (as determined from the relationship of sample-tree volume and sample-tree growth by type, stand-size, stocking, species, and diameter-class groups) and total inventory volumes by the same stratifications. Net growth was calculated by subtracting mortality from gross growth.

Commodity Drain

Commodity drain for both sampled and complete survey areas is based chiefly on the reports of producing or consuming agencies, with adjustments for waste as determined from woods and mill-scale studies. Approximately 88 percent of the board-foot drain estimates were derived from a complete canvass of sawmills, pulp mills, pole manufacturers, railroads, and mines. The remainder, consisting chiefly of drain for posts and fuel wood, was derived in part from production and sales reports, and in part from consumption ratios, i. e., fence posts used by size of farm.

Mortality

Mortality in "growing stands" of the area covered by complete survey was based on a tally of trees judged to have died within the 10-year period of the growth study. Mortality of "nongrowing stands" was derived by applying the mortality percent of "growing stands" to the volume of "nongrowing stands."

Mortality for the sample survey was based on a tally of trees judged to have died during the last half of the growth-study period (5 years) on each 1/5-acre plot sampled for inventory. The 5-year mortality was doubled to obtain mortality for the entire growth-study period.

Accuracy of Estimates

Area

In determining the extent of various cover types and stand-size classes, there are two possible sources of error—errors in classifying the cover of the field samples and in compiling the field data; and sampling errors. The former result from mistakes of judgment or technique and from the complexity of the cover which often grades from one class into another with no clearly defined boundaries. It is seldom possible to evaluate such errors. An effort was made to maintain a high order of accuracy and uniformity of standards in the classification, collection, and compilation of sample data by field checks, by a continuing program of training, and by cross checks in the office.

Sampling errors (standard errors), on the other hand, do not involve human errors, but rather are theoretical measures of the reliability of estimates based on the variability of sample measurements. They generally vary inversely with the square root of the number of samples and directly with the square root of the unsampled part of the total population. Hence, they can be controlled by altering either the number of samples, the size of individual samples, or both.

Area estimates for the part covered by complete survey have no sampling errors. For the part covered by sampling, the probabilities are 2 out of 3 that sampling errors are within the following limits:

	Estimated area (acres)	*Standard error (acres)*	*(percent)*
Total forest land	7,321,000	±146,000	±2.0
Commercial forest land	5,874,000	±152,000	±2.6
Noncommercial and reserved forest land	1,447,000	± 63,000	±4.4

For the State as a whole, considering sampling and technique errors for the sampled area and technique errors for the area covered by complete survey, it is judged that actual areas lie between the following limits:

	Million acres
Total forest land	22.3–22.5
Commercial forest land	15.7–15.9
Noncommercial and reserved forest land	6.5– 6.7

Volume

In determining timber volume, the possible sources of error, in addition to those cited under "Area" and "Growth," include: inaccurate measurement of sample plots, tree diameters, tree heights, cull, and bias resulting from the improper construction, selection, and use of tree-volume tables. All reasonable effort was made to eliminate errors from these sources.

Sampling errors for the area covered by sampling are ±3.2 percent or ±212 million cubic feet for the primary growing stock and ±9.0 percent or ±1,397 billion board feet for the live saw-timber estimate.

Comparison of survey volumes and cutting records indicates that the volume estimates for the area covered by complete survey are slightly low. Taking into account this indicated bias, and the sampling errors of volume estimates on the sampled area, the true volumes for the State as a whole are estimated to lie within the following limits: primary growing stock, 16 to 17 billion cubic feet; live saw timber, 55 to 58 billion board feet.

Growth

In estimating timber growth, the possible sources of error, in addition to those cited under "Area" and "Volume," include: errors in measuring increment cores, in reconstructing tree volumes, and in dating mortality. All practical efforts were made to eliminate errors from these sources. Growth estimates for the area covered by complete survey are believed to be somewhat low. As mentioned under "Methods," the original growth calculation for that part of the State excluded approximately one-third of the commercial area where stand volume was in a more or less static condition. It appears now that there may actually have been some net growth in these stands in recent years.

For the area sampled, standards errors of net growth are ±8.4 percent, or ±11 million cubic feet for primary growing stock, and ±15 percent, or ±36 million board feet for saw-timber trees.

Actual growth for the State as a whole, including judgment estimates of growth on stands previously considered nonproductive, is estimated to lie between the following limits:

	Primary growing stock (million cubic feet)	*Live saw-timber trees (million board feet)*
Gross annual growth	290–320	840–930
Net annual growth	240–280	600–700

Commodity Drain

Estimates of commodity drain are based chiefly on a complete tabulation of production and consumption statistics, adjusted for waste on the basis of woods and mill studies. Only 18 percent of the cubic-foot and 12 percent of the board-foot drain is based on sampling. However, the translation of production statistics into drain introduces an indeterminable error. The commodity drain estimates for the State as a whole during the period 1939–48 are judged to be between 90 and 100 million cubic feet of primary growing stock and between 520 and 550 million board feet of saw-timber volume.

Comparison of 1949 and Earlier Estimates

At least six different estimates of Montana's timber resources have been published in the past (table 19). Differences between the 1949 and earlier estimates are accounted for by sampling errors in the statistics derived by sampling;[20] technique errors; variations in definitions, inclusiveness, and standards of measurement; and actual change.

The apparent increase in total forest and commercial forest land can be at least partially accounted for by changes in definition and inclusiveness. Prior to the completion of the systematic survey in 1949, only extensive estimates were available for the area east of the Continental Divide. Hardwood areas and volumes were desregarded entirely prior to 1938. Furthermore, the present estimate of the commercial forest area includes a considerable area formerly classed as noncommercial. Volume estimates of 1918 and 1925 include all forest land as indicated in table 19, whereas later estimates are for commercial forests only. Part, and perhaps all, of the apparent differences may be accounted for by differences in definition of what constitutes a saw-timber tree.

For the foregoing reasons, a comparison of the 1949 and previous estimates provides no definite indication of quantitative changes or trends. There have, of course, been changes in the character and distribution of the timber volume. It is particularly evident that the proportion of the volume in prized species such as ponderosa and western white pine is diminishing, and that the volume of these and other species is becoming less concentrated in large blocks.

Conditional Allowable Annual Cut

The estimates of allowable annual cut presented in this report are based on allowable annual drain calculations, discounted approximately 25 percent to allow for abnormal mortality and other factors that may prevent utilization of total yields. They rest on the assumption that forest-management practices and protection will be improved to the point where the stands of the future will be as productive as the ones being cut now.

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[20] Approximately one-third of the forest area was derived by sampling, the remaining two-thirds from complete surveys (p. 56).

They are predicated also upon ultimate utilization of the full area classified as commercial by the Forest Survey, utilization up to Forest Survey standards, and salvage of such losses as may be caused by large fires, insect and disease epidemics, etc.

The allowable annual drain calculations were derived for each forest type by the following formula:

$$\left(\frac{7A + 5A_1 + 3A_2 + A_3}{4R}\right) M_A$$

The coefficients 7, 5, 3, and 1 (implied) are growing stock weights for the respective stand-size classes based on the familiar triangular diagram used to depict the growing stock of a normal forest.

A=area of saw-timber stands.
A_1=area of pole-timber stands.
A_2=area of seedling and sapling stands.
A_3=nonstocked area.
$A + A_1 + A_2 + A_3$=total commercial forest land area.
4=number of stand-size classes.
R=rotation in years.
M=average volume per acre (by species) of current saw-timber stands—the "A" stratum.

The rotations assumed were as follows:

Forest type:[1]	Rotation in years Western Montana	 Eastern Montana
White pine	120	...
Ponderosa pine	150	160
Larch	150	...
Douglas-fir	150	200
Lodgepole pine	100	140
Whitebark and limber pine	...	140
Spruce	120	120
Hemlock-grand fir	120	...
Alpine fir	...	140
Western redcedar	120	...
Cottonwood	100	100
Aspen and other hardwoods	...	80

[1] No allowable drain was calculated for the coniferous woodland type.

The allowable annual drain as derived includes only the final harvest yield, i. e., no allowance is made for normal losses of which, under intensive management practices, considerable portions may be salvaged, nor the possibilities of additional yields from intermediate cuttings.

Definitions

Forest Land Classes

Forest Land.—Includes (*a*) lands at least 10-percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime; (*b*) land from which the trees described in (*a*) have been removed to less than 10-percent stocking and which have not been developed for other use; and (*c*) afforested areas. The minimum area for forest-land classification was 10 acres with a minimum width of 120 feet.

Commercial forest land.—Forest land which is (*a*) producing, or is physically capable of producing, usable crops of wood (usually saw timber), (*b*) economically available now or prospectively, and (*c*) not withdrawn from timber utilization.

Noncommercial forest land.—Forest land incapable of yielding usable wood products (usually saw timber) because of adverse site conditions, or so physically inaccessible as to be permanently unavailable economically and not withdrawn for special purposes.

Reserved forest land.—Forest land that has been withdrawn from timber utilization through statute, ordinance, or administrative order.

Reserved commercial forest land.—Reserved forest land that otherwise qualifies as commercial forest land.

Reserved noncommercial forest land.—Reserved forest land that otherwise qualifies as noncommercial forest land.

Forest Stand-Size Classes

Saw-timber stands.—All stands with saw-timber trees of softwoods and/or hardwoods having a minimum volume of 1,500 board feet per acre, International ¼-inch rule.

Pole-timber stands.—Stands failing to meet the saw-timber stands specification, but at least 10-percent stocked with pole-timber and larger (5.0 inches d. b. h. and larger) trees, and with at least half the minimum stocking in pole-timber trees.

Seedlings and sapling stands.—Forest stands not qualifying as either saw-timber or pole-timber stands, but having at least 10-percent stocking of trees and with at least half the minimum stocking in seedlings and saplings.

Nonstocked and other areas not elsewhere classified.—Areas not qualifying as saw-timber, pole-timber, or seedling-sapling stands.

Forest Type Classes

White pine group:

White pine.—Forests in which 20 percent or more of the stand is western white pine.

Western redcedar.—Forests in which 50 percent or more of the stand is western redcedar and less than 20 percent is western white pine.

Ponderosa pine.—Forests in which 50 percent or more of the stand is ponderosa pine and less than 20 percent is western white pine.

Larch.—Forests in which 50 percent or more of the stand is larch and less than 20 percent is western white pine.

Douglas-fir.—Forests in which 50 percent or more of the stand is Douglas-fir and less than 20 percent is western white pine.

Lodgepole pine group:

Lodgepole pine.—Forests in which 50 percent or more of the stand is lodgepole pine and less than 20 percent is western white pine.

Whitebark and limber pine.—Forests in which 50 percent or more of the stand is whitebark and/or limber pine and less than 20 percent is western white pine.

Spruce-fir group:

Spruce.—Forests in which 50 percent or more of the stand is Engelmann spruce and/or western white spruce and less than 20 percent is western white pine.

Hemlock–grand fir.—Forests in which 50 percent or more of the volume is hemlock and/or grand fir and less than 20 percent is western white pine.

Alpine fir.—Forests in which 50 percent or more of the stand is alpine fir and less than 20 percent is western white pine.

Hardwoods.—Forests in which 50 percent or more of the stand is hardwood species and less than 20 percent is western white pine.

Coniferous woodland.—Open, scraggly commercial forests in which 50 percent or more of the stand is juniper, ponderosa pine, Douglas-fir, and lodgepole pine, singly or in combination.

Ownership Classes

National-forest ownership. — Federal lands which, by executive order or statute, have been designated as national forests, purchase units, or experimental areas, or have been placed under the administration of the Forest Service.

Indian ownership.—Indian tribal lands and trust allotments. Lands held in fee by the Federal Government but administered and managed for Indian tribal groups, or allotted in trust to individual Indians.

Other Federal ownership.—Lands owned by the Federal Government not classed as national forest or Indian.

State ownership.—Lands in State ownership.

County and muncipal ownership.—Lands in county or municipal ownership.

Private ownership.—Lands in private ownership.

Private farm ownership.—Private commercial forest land in farms, using as the definition of "farm" the official definition in the latest Census of Agriculture.

Other private ownership.—Commercial forest land in private ownership other than farm.

Tree-Merchantability Classes (Live)

Live saw-timber trees.—Live white pine saw-timber trees in which the merchantable portion is 40 percent or more of the total board-foot volume; live saw-timber trees of other species that are at least 50 percent merchantable by board-foot volume.

Cull saw-timber trees.—Live white pine saw-timber trees in which the unmerchantable portion exceeds 60 percent, and live saw-timber trees of other species in which the unsound portion exceeds 50 percent of total board-foot volume.

Sound cull saw-timber trees.—Live saw-timber trees in which the unmerchantable portion results from defect other than rot, for example, sweep, frost crack, extreme roughness, fire scar, etc.

Rotten cull saw-timber trees.—Live saw-timber trees in which the unmerchantable portion results from decay organisms.

Live pole-timber trees.—Live pole-timber trees of all species that are judged to be prospectively merchantable for sawlogs.

Cull pole-timber trees.—Live pole-timber trees of all species that are judged to be prospectively unmerchantable for sawlogs.

Sound cull pole-timber trees.—Live pole-timber trees judged unmerchantable now or prospectively because of defect other than rot.

Rotten cull pole-timber trees.—Live pole-timber trees judged unmerchantable now or prospectively because of rot.

Tree-Merchantability Classes (Dead)

Dead saw-timber trees.—Dead, standing or down, saw-timber trees of all species having a merchantable volume of 50 percent or more of the total board-foot volume.

Dead pole-timber trees.—Dead, standing or down, pole-timber trees of all species with 50 percent or more of the cubic volume merchantable.

Tree-Size Classes

Saw-timber trees.—Trees 11.0 inches d. b. h. and larger with one or more merchantable 16-foot sawlogs.

Pole-timber trees.—Trees ranging from 5.0 through 10.9 inches d. b. h. and trees over 11.0 inches d. b. h. that do not contain at least one merchantable 16-foot sawlog.

Seedling and sapling trees.—Trees below 5.0 inches d. b. h.

Miscellaneous Definitions

Primary growing stock.—Net volume, in cubic feet, of live saw-timber trees, and live pole-timber trees from stump to a minimum 4.0-inch top (of central stem) inside bark.

Secondary growing stock.—Net volume in cubic feet of all cull trees from stump to a minimum 4.0-inch top inside bark, and limbs to a 4.0-inch diameter inside bark of all cull and noncull hardwood trees.

All-timber volume.—The net volume of primary growing stock, secondary growing stock, and salvable dead trees.

Sawlog portion.—The net board-foot volume, as measured by International ¼-inch rule, of saw-timber trees from stump to a merchantable sawlog top. Tops vary by species and diameter class, ranging from 6.0 inches for small trees up to 22.0 inches for very large rough trees.

Top portion.—The net cubic foot volume of saw-timber trees from the merchantable sawlog top to 4.0 inches inside bark.

Live pole-timber volume.—The net cubic-foot volume of live pole-timber trees from stump to a 4.0-inch top inside bark.

Net board-foot volume.—The board-foot volume of the sawlog portion of saw-timber trees, as measured by International ¼-inch rule, after deduction for all apparent and surmised defect in accordance with standard scaling practice.

Net cubic volume.—The total cubic-foot volume discounted for unmerchantable material. Includes the merchantable portion only of sound, sound cull, and rotten cull saw-timber and pole-timber trees and hardwood limbs larger than a 4.0-inch top diameter.

Net annual growth.—The average annual change during a specified period in volume of primary growing stock on commercial forest land resulting from natural causes. Gross growth is the increment before allowance for mortality.

D. b. h. (diameter breast high).—Tree diameter in inches, outside bark, measured 4½ feet above average ground level.

Commodity production.—The total output of timber products during a specified year.

Commodity drain.—The timber volume removed from primary growing stock as timber products and logging waste during a specified year.

Control point.—Land Office section corners (in unsurveyed areas idealized section corners as indicated on latest base map) used to locate and define the boundaries of sampling strata and sample segments.

Trees Native to Montana

CONIFERS

Commercial species:

Douglas-fir	*Pseudotsuga taxifolia*
Fir, alpine	*Abies lasiocarpa*
Fir, grand	*A. grandis*
Hemlock, mountain	*Tsuga mertensiana*
Hemlock, western	*T. heterophylla*
Juniper, Rocky Mountain	*Juniperus scopulorum*
Larch, alpine	*Larix lyalli*

CONIFERS—Continued

Larch, western	*L. occidentalis*
Pine, limber	*Pinus flexilis*
Pine, lodgepole	*P. contorta* var. *latifolia*
Pine, ponderosa	*P. ponderosa*
Pine, western white	*P. monticola*
Pine, whitebark	*P. albicaulis*
Redcedar, western	*Thuja plicata*
Spruce, Engelmann	*Picea engelmanni*
Spruce, western white	*P. glauca* var. *albertiana*
Noncommercial species: Pacific Yew	*Taxus brevifolia*

HARDWOODS

Commercial species:	
Ash, green	*Fraxinus pennsylvanica* var. *lanceolata*
Aspen, quaking	*Populus tremuloides*
Birch, paper	*Betula papyrifera*
Birch, water	*B. fontinalis*
Boxelder, inland	*Acer negundo* var. *interius*
Cottonwood, northern black	*Populus trichocarpa* var. *hastata*
Cottonwood, narrowleaf	*P. angustifolia*
Cottonwood, plains	*P. sargentii*
Elm, American	*Ulmus americana*
Willow	*Salix* spp.
Noncommercial species:	
Alder, thinleaf	*Alnus tenuifolia*
Chokecherry, black	*Prunus virginiana* var. *melanocarpa*
Hawthorn, black	*Crataegus douglasii*
Maple, bigtooth	*Acer grandidentatum*
Maple, Rocky Mountain	*A. glabrum*
Mountain-ash, western	*Sorbus sitchensis*
Mountain-mahogany, curlleaf	*Cercocarpus ledifolius*

Supplemental Tables

TABLE 3.—*Land area by major classes of forest land, Montana, 1949*

Class of land	Western Montana	Eastern Montana	State
	1,000 Acres	*1,000 Acres*	*1,000 Acres*
Forest:			
Commercial	8,909	6,847	15,756
Noncommercial	2,512	1,564	4,076
Reserved:[1]			
Commercial	603	467	1,070
Noncommercial	995	462	1,457
Total	1,598	929	2,527
Total forest	13,019	9,340	22,359
Nonforest[2]	2,959	68,324	71,283
Total, all classes	15,978	77,664	93,642

[1] The reserved forest area is further classified in table 17.

[2] Includes 171,689 acres of water according to Survey standards of area classification but defined by the Bureau of Census as land.

TABLE 4.—*Volume of live saw timber and primary growing stock on commercial forest land by stand-size class, Montana, 1949*

Stand-size class	Live saw timber[1]			Primary growing stock		
	Western Montana	Eastern Montana	State	Western Montana	Eastern Montana	State
	Million board feet	*Million board feet*	*Million board feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Saw timber	34,763	11,342	46,105	6,715	3,845	10,560
Pole timber	4,292	4,520	8,812	1,999	2,948	4,947
Seedling and sapling	596	75	671	428	78	506
Nonstocked and other areas	38	334	372	18	150	168
Total, all stands	39,689	16,271	55,960	9,160	7,021	16,181

[1] International ¼-inch rule.

TABLE 5.—*Commercial forest land area by ownership and stand-size class, Montana, 1949*

STATE

Stand-size class	Total, all ownerships	Federally owned or managed				State	County	Private		
		National forest	Indian	Other	Total			Farm	Industrial and other	Total
	1,000 acres	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*
Saw timber	5,699	3,337	264	139	3,740	251	12	333	1,363	1,696
Pole timber	6,333	3,664	241	296	4,201	205	21	1,185	721	1,906
Seedling and sapling	2,412	1,590	69	52	1,711	92	25	280	304	584
Nonstocked and other areas	1,312	390	20	159	569	60	17	564	102	666
Total	15,756	8,981	594	646	10,221	608	75	2,362	2,490	4,852

WESTERN MONTANA

Stand-size class	Total, all ownerships	National forest	Indian	Other	Total	State	County	Farm	Industrial and other	Total
Saw timber	3,740	2,018	224	48	2,290	217	10	56	1,167	1,223
Pole timber	2,959	1,666	96	93	1,855	120	5	533	446	979
Seedling and sapling	1,854	1,184	49	28	1,261	85	24	213	271	484
Nonstocked and other areas	356	200	11	8	219	24	....	29	84	113
Total	8,909	5,068	380	177	5,625	446	39	831	1,968	2,799

EASTERN MONTANA

Stand-size class	Total, all ownerships	National forest	Indian	Other	Total	State	County	Farm	Industrial and other	Total
Saw timber	1,959	1,319	40	91	1,450	34	2	277	196	473
Pole timber	3,374	1,998	145	203	2,346	85	16	652	275	927
Seedling and sapling	558	406	20	24	450	7	1	67	33	100
Nonstocked and other areas	956	190	9	151	350	36	17	535	18	553
Total	6,847	3,913	214	469	4,596	162	36	1,531	522	2,053

TABLE 6.—*Volume of live saw timber and primary growing stock on commercial forest land, by ownership class, Montana, 1949*

Ownership class	Live saw timber[1]			Primary growing stock		
	Western Montana	Eastern Montana	State	Western Montana	Eastern Montana	State
	Million board feet	*Million board feet*	*Million board feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Federally owned or managed:						
National forest	21,655	11,489	33,144	4,904	5,075	9,979
Indian	1,961	252	2,213	399	116	515
Other	471	712	1,183	126	281	407
Total	24,087	12,453	36,540	5,429	5,472	10,901
State	2,416	255	2,671	575	99	674
County	95	21	116	26	9	35
Private:						
Farm	1,460	1,871	3,331	463	710	1,173
Industrial and other	11,631	1,671	13,302	2,667	731	3,398
Total	13,091	3,542	16,633	3,130	1,441	4,571
Total, all ownerships	39,689	16,271	55,960	9,160	7,021	16,181

[1] International ¼-inch rule.

TABLE 7.—*Volume of live saw timber and primary growing stock on commercial forest land, by species, Montana, 1949*

Species	Live saw timber[1]			Primary growing stock		
	Western Montana	Eastern Montana	State	Western Montana	Eastern Montana	State
	Million board feet	*Million board feet*	*Million board feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Softwoods:						
Western white pine	1,119	...	1,119	237	...	237
Ponderosa pine	9,328	1,641	10,969	1,581	650	2,231
Larch	11,760	(2)	11,760	2,408	...	2,408
Douglas-fir	8,978	6,381	15,359	2,597	2,095	4,692
Grand fir	393	...	393	165	...	165
Alpine fir	353	257	610	88	169	257
Western redcedar	356	...	356	120	...	120
Western hemlock	171	...	171	56	...	56
Spruce	4,454	2,499	6,953	826	565	1,391
Lodgepole pine	2,496	4,451	6,947	997	3,080	4,077
Whitebark and limber pine	124	504	628	34	261	295
Juniper	...	...	...	1	3	4
Total	39,532	15,733	55,265	9,110	6,823	15,933
Hardwoods:						
Aspen	2	14	16	11	65	76
Cottonwood	155	522	677	39	127	166
Birch	(2)	...	(2)	(2)	...	(2)
Boxelder	...	1	1	...	1	1
Green ash	...	1	1	...	5	5
Willow	...	(2)	(2)	...	(2)	(2)
Elm	...	(2)	(2)	...	(2)	(2)
Total	157	538	695	50	198	248
Total, all species	39,689	16,271	55,960	9,160	7,021	16,181

[1] International ¼-inch rule.

[2] Less than 0.5 million feet.

TABLE 8.—*All-timber volume on commercial forest land, by kind of timber, Montana, 1949*

Kind of timber	Western Montana	Eastern Montana	State
	Million cubic feet	*Million cubic feet*	*Million cubic feet*
Live:			
Primary growing stock	9,160	7,021	16,181
Secondary growing stock	144	114	258
Total	9,304	7,135	16,439
Dead	119	423	542
Total, all timber	9,423	7,558	16,981

TABLE 9.—*Net annual growth and annual mortality of live saw timber and primary growing stock on commercial forest land by species group, Montana*[1]

Species group	Live saw timber[2]		Primary growing stock	
	Current annual net growth	Current annual mortality	Current annual net growth	Current annual mortality
	Million board feet	*Million board feet*	*Million cubic feet*	*Million cubic feet*
Softwoods:				
Western Montana	344	176	96	29
Eastern Montana	244	67	137	20
Total	588	243	233	49
Hardwoods:				
Western Montana	2	(3)	1	(3)
Eastern Montana	16	(3)	7	1
Total	18	(3)	8	1
All Species:				
Western Montana	346	176	97	29
Eastern Montana	260	67	144	21
Total	606	243	241	50

[1] Growth for Western Montana is an average based on the period 1930-39, and for Eastern Montana, 1940-49.

[2] International ¼-inch rule.

[3] Less than 0.5 million feet.

TABLE 10.—*Average annual commodity drain of live saw-timber volume and primary growing stock on commercial forest land, by species group, Montana, 1939–48*

Species group	Live saw timber[1]			Primary growing stock		
	Cutting drain	Logging waste	Commodity drain[2]	Cutting drain	Logging waste	Commodity drain[2]
	Million board feet	*Million board feet*	*Million board feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Softwoods:						
Western Montana	440	35	475	69	11	80
Eastern Montana	26	1	27	8	1	9
Total	466	36	502	77	12	89
Hardwoods:						
Western Montana	4	....	4	1	....	1
Eastern Montana	21	1	22	4	....	4
Total	25	1	26	5	....	5
All species:						
Western Montana	444	35	479	70	11	81
Eastern Montana	47	2	49	12	1	13
Total	491	37	528	82	12	94

[1] International ¼-inch rule.

[2] Total of cutting drain and logging and milling waste.

Table 11.—*Average annual commodity production, by timber products, in cubic volume and in standard units, Montana, 1939–48*

CUBIC VOLUME

Timber products	Western Montana	Eastern Montana	State
	Thousand cubic feet	*Thousand cubic feet*	*Thousand cubic feet*
Sawlogs (for lumber, timbers, and sawn ties)	59,020	2,373	61,393
Pulpwood logs	652	....	652
Pulpwood bolts	70	527	597
Fuel wood	6,289	9,828	16,117
Poles and piling	1,503	235	1,738
Posts (round and split)	1,136	3,241	4,377
Hewn ties	41	1	42
Round mine timbers	3,564	1,265	4,829
Miscellaneous	233	8	241
Total[1]	72,508	17,478	89,986

STANDARD UNITS

Timber products	Western Montana	Eastern Montana	State
Sawlogs (for lumber, timbers, and sawn ties) M board feet[2]	399,201	14,120	413,321
Pulpwood logs........do[2]	4,061	....	4,061
Pulpwood bolts Standard cords[3]	811	5,919	6,730
Fuel wood............do[3]	73,128	114,279	187,407
Poles and piling.......Pieces	107,090	18,156	125,246
Posts (round and split)...do	1,058,296	3,792,778	4,851,074
Hewn ties.............do	6,020	102	6,122
Round mine timbers.....do	494,126	167,556	661,682
Miscellaneous.......cubic feet	233,444	6,841	240, 2

[1] Western Montana total includes 2,771 M cubic feet dead trees, and eastern Montana 5,130 M cubic feet.

[2] International ¼-inch rule.

[3] Rough wood, unpeeled. A pile of stacked wood 4 by 4 by 8 feet within its outside surface.

Table 12.—*Area of commercial forest land, by generalized forest type and stand-size class, Montana, 1949*

STATE

Forest type	Stand-size class: Saw timber	Pole timber	Seedling and sapling	Non-stocked and other areas	Total
	1,000 acres	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*
White pine group:					
White pine	156	63	93	20	332
Cedar	12	1	4	....	17
Total	168	64	97	20	349
Ponderosa pine	1,580	1,426	304	115	3,425
Larch	1,338	492	622	109	2,561
Douglas-fir	1,216	1,327	184	136	2,863
Lodgepole pine group:					
Lodgepole pine	725	2,719	1,031	97	4,572
Whitebark and limber pine	67	29	3	1	100
Total	792	2,748	1,034	98	4,672
Spruce-fir group:					
Spruce	475	33	99	32	639
Hemlock-grand fir	4	4	....	....	8
Alpine fir	6	7	12	....	25
Total	485	44	111	32	672
Hardwoods	120	232	60	2	414
Coniferous woodland	....	....	....	800	800
Total, all types	5,699	6,333	2,412	1,312	15,756

WESTERN MONTANA

Forest type	Saw timber	Pole timber	Seedling and sapling	Non-stocked and other areas	Total
White pine group:					
White pine	156	63	93	20	332
Cedar	12	1	4	....	17
Total	168	64	97	20	349
Ponderosa pine	1,346	542	264	85	2,237
Larch	1,338	492	622	109	2,561
Douglas-fir	357	582	140	66	1,145
Lodgepole pine	199	1,204	710	52	2,165
Spruce-fir group:					
Spruce	310	25	21	24	380
Hemlock-grand fir	4	4	....	....	8
Total	314	29	21	24	388
Hardwoods	18	46	....	(1)	64
Total, all types	3,740	2,959	1,854	356	8,909

EASTERN MONTANA

Forest type	Saw timber	Pole timber	Seedling and sapling	Non-stocked and other areas	Total
Ponderosa pine	234	884	40	30	1,188
Douglas-fir	859	745	44	70	1,718
Lodgepole pine group:					
Lodgepole pine	526	1,515	321	45	2,407
Whitebark and limber pine	67	29	3	1	100
Total	593	1,544	324	46	2,507
Spruce-fir group:					
Spruce	165	8	78	8	259
Alpine fir	6	7	12	....	25
Total	171	15	90	8	284
Hardwoods	102	186	60	2	350
Coniferous woodland	....	....	....	800	800
Total, all types	1,959	3,374	558	956	6,847

[1] Less than 0.5 thousand acres.

Table 13.—*Live all-timber volume of softwoods and hardwoods on commercial forest land, by kind of growing stock, tree-size class, and class of material, Montana, 1949*

Kind of growing stock, tree-size class, and class of material	Western Montana			Eastern Montana			State		
	Soft-woods	Hard woods	Total	Soft woods	Hard woods	Total	Soft-woods	Hard-woods	Total
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Primary growing stock:									
Live saw-timber trees:									
Sawlog portion	5,393	27	5,420	2,589	86	2,675	7,982	113	8,095
Top portion	532	4	536	376	24	400	908	28	936
Total	5,925	31	5,956	2,965	110	3,075	8,890	141	9,031
Live pole-timber trees	3,185	19	3,204	3,858	88	3,946	7,043	107	7,150
Total primary growing stock	9,110	50	9,160	6,823	198	7,021	15,933	248	16,181
Secondary growing stock:									
Sound cull trees:									
Saw-timber size	6	(1)	6	4	....	4	10	(1)	10
Pole-timber size	1	(1)	1	1	....	1	2	(1)	2
Total	7	(1)	7	5	....	5	12	(1)	12
Rotten cull trees	133	3	136	96	10	106	229	13	242
Limbs	....	1	1	....	3	3	....	4	4
Total secondary growing stock	140	4	144	101	13	114	241	17	258
Grand total	9,250	54	9,304	6,924	211	7,135	16,174	265	16,439

[1] Less than 0.5 million cubic feet.

Table 14.—*Volume of live saw timber*[1] *on commercial forest land, by diameter class groups and by species, Montana, 1949*

Species	Western Montana				Eastern Montana			State			
	11.0–20.9″	21.0–30.9″	31.0–40.9″	41.0″ and larger	11.0–20.9″	21.0–30.9″	31.0–40.9″	11.0–20.9″	21.0–30.9″	31.0–40.9″	41.0″ and larger
	Million board feet	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*
Western white pine	548	535	26	10	....	....	....	548	535	26	10
Ponderosa pine	2,230	4,829	2,050	219	1,371	264	6	3,601	5,093	2,056	219
Larch	3,291	5,561	2,591	317	(2)	(2)	....	3,291	5,561	2,591	317
Douglas-fir	5,088	3,480	395	15	4,592	1,565	224	9,680	5,045	619	15
Grand fir	361	32	....	....	....	....	....	361	32	....	....
Alpine fir	332	21	....	....	254	3	....	586	24	....	....
Western redcedar	33	222	101	....	....	....	....	33	222	101	....
Western hemlock	68	95	8	....	....	....	....	68	95	8	....
Spruce	1,965	2,203	286	....	1,719	700	80	3,684	2,903	366	....
Lodgepole pine	2,488	8	....	....	4,369	82	....	6,857	90	....	....
Whitebark and limber pine	124	....	....	....	479	25	....	603	25	....	....
Cottonwood	43	107	5	(2)	321	168	33	364	275	38	(2
Aspen	2	....	....	....	14	....	....	16	....	....	....
Birch	(2)	....	....	....	....	....	....	( )	....	....	....
Boxelder	....	....	....	....	1	....	....	1	....	....	....
Green ash	....	....	....	....	1	....	....	1	....	....	....
Willow	....	....	....	....	(2)	....	....	(2)	....	....	....
Elm	....	....	....	....	(2)	....	....	(2)	....	....	....
Total	16,573	17,093	5,462	561	13,121	2,807	343	29,694	19,900	5,805	561

[1] International ¼-inch rule, diameter breast high.

[2] Less than 0.5 million board feet.

TABLE 15.—*Net growth, normal mortality, and commodity drain on primary growing stock on commercial forest land by tree-size class, Montana* [1]

Size class	Net growth	Normal mortality	Commodity drain
	Million cubic feet	*Million cubic feet*	*Million cubic feet*
Saw-timber trees:			
Western Montana	52	26	78
Eastern Montana	42	14	9
Total	94	40	87
Pole-timber trees:			
Western Montana	45	3	3
Eastern Montana	102	7	4
Total	147	10	7
All trees:			
Western Montana	97	29	81
Eastern Montana	144	21	13
Total	241	50	94

[1] Growth and mortality for western Montana are averages based on the period 1930-39; for eastern Montana, 1940-49. Commodity drain is an average based on the period 1939-48.

TABLE 16.—*Comparison of average annual and 1948 cuts with conditional allowable annual cut of live, sound timber, by species, Montana*

Species	Saw-timber trees [1]			Pole-timber trees			All trees		
	Average annual cut 1939–48	1948 cut	Conditional allowable cut	Average annual cut 1939–48	1948 cut	Conditional allowable cut	Average annual cut 1939–48	1948 cut	Conditional allowable cut
	Million board feet	*Million board feet*	*Million board feet*	*1,000 cords*	*1,000 cords*	*1,000 cords*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Western Montana:									
Ponderosa pine	187	231	99	3	4	3	29	33	15
White pine	16	14	18	....	....	1	3	2	3
Larch and Douglas-fir	243	357	280	21	16	64	42	57	48
Lodgepole pine	3	4	74	13	13	82	2	2	20
Other species	30	26	89	1	2	17	5	4	17
Total	479	632	560	38	35	167	81	98	103
Eastern Montana:									
Ponderosa pine	9	8	23	16	12	7	2	2	6
Larch and Douglas-fir	9	19	85	8	7	91	3	4	27
Lodgepole pine	8	13	131	16	35	260	3	5	53
Other species	23	10	62	11	10	110	5	4	23
Total	49	50	301	51	64	468	13	15	109
State:									
Ponderosa pine	196	239	122	19	16	10	31	35	21
White pine	16	14	18	....	....	1	3	2	3
Larch and Douglas-fir	252	376	365	29	23	155	45	61	75
Lodgepole pine	11	17	205	29	48	342	5	7	73
Other species	53	36	151	12	12	127	10	8	40
Total	528	682	861	89	99	635	94	113	212

[1] International ¼-inch rule.

TABLE 17.—*Area of major classes of forest land, by ownership, Montana, 1949*

Ownership class	Western Montana				Eastern Montana				State			
	Commercial	Noncommercial	Reserved	Total	Commercial	Noncommercial	Reserved	Total	Commercial	Noncommercial	Reserved	Total
	1,000 acres	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*
Federally owned or managed:												
National forest	5,068	2,116	1,006	8,190	3,913	1,317	503	5,733	8,981	3,433	1,509	13,923
Indian	380	95	....	475	214	23	....	237	594	118	....	712
Other	177	28	518	723	469	34	426	929	646	62	944	1,652
Total	5,625	2,239	1,524	9,388	4,596	1,374	929	6,899	10,221	3,613	2,453	16,287
State	446	40	....	486	162	10	....	172	608	50	....	658
County	39	1	....	40	36	5	....	41	75	6	....	81
Private:												
Farm	831	50	....	881	1,531	63	....	1,594	2,362	113	....	2,475
Industrial and other	1,968	182	74	2,224	522	112	....	634	2,490	294	74	2,858
Total	2,799	232	74	3,105	2,053	175	....	2,228	4,852	407	74	5,333
Total, all ownerships	8,909	2,512	1,598	13,019	6,847	1,564	929	9,340	15,756	4,076	2,527	22,359

TABLE 18.—*Area of forest in major reserved forest areas, Montana*

Reserved forest	Total area
	1,000 acres
Yellowstone National Park [1]	140
Glacier National Park	793
Wild and wilderness areas in national forests	1,509
Total	2,442

[1] Montana part only.

TABLE 19.—*Forest area and timber-volume estimates for Montana, by specified years, 1918–49* [1]

Date	Forest land area			Saw-timber volume [2]
	Commercial	Other	Total	
	Thousand acres	*Thousand acres*	*Thousand acres*	*Million ft. b. m.*
1918	....	....	....	58,000
1920	13,926	....	....	....
1925	14,696	5,926	20,622	50,009
1932	14,865	5,821	20,686	49,796
1938	14,613	6,074	20,687	49,963
1945	14,758	9,480	24,238	52,515
1949	15,756	6,603	22,359	55,960

[1] Only data for 1949 are based on a systematic field survey of the entire State. Data for the other years are from the following sources:

1918. Fifth Biennial Report of the State Forester of Montana, 1917-18.

1920. U. S. Dept. Agr. Stat. Bul. 21, American Forests and Forest Products. 1928.

1925. Univ. Mont. and U. S. Forest Service. Montana Forest and Timber Handbook. 1926.

1932. U. S. Dept. Agr., Forest Serv., Region 1. Basic data for Sen. Doc. 12, 73d Cong., 1st sess. 1931.

1938. U. S. Cong., Joint Committee on Forestry. Sen. Doc. 32, 77th Cong., 1st sess. 1941.

1945. Forest Service basic statistics for U. S. Dept. Agr. Misc. Pub. 668, Forests and National Prosperity. 1948.

[2] Volume estimates for 1918 and 1925 include all forest land; the later estimates are for commercial forests only. Minimum standards for saw-timber trees were not defined for estimates prior to 1945. The 1945 estimates included pines and hardwoods 11.0 inches d. b. h. and larger; minimum diameter of all other species was 13.0 inches. In 1949, the minimum standard was 11.0 inches d. b. h. and larger for all species.

TABLE 20.—*Relationship of forest land area of Montana to total land area, by county, 1949*

County[1]	Forest land			Total land area	Percent of total land area in forest land
	Commercial	Noncommercial and reserved	Total		
	Acres	*Acres*	*Acres*	*Acres*	
Beaverhead	862,997	197,557	1,060,554	3,555,840	29.8
Big Horn	179,185	22,381	201,566	3,221,120	6.3
Blaine	80,872	6,528	87,400	2,730,880	3.2
Broadwater	170,777	16,260	187,037	795,520	23.5
Carbon	86,793	98,796	185,589	1,324,800	14.0
Carter	56,527	....	56,527	2,120,320	2.7
Cascade	234,323	84,568	318,891	1,701,120	18.7
Chouteau	51,037	8,521	59,558	2,508,800	2.4
Custer	25,092	....	25,092	2,409,600	1.0
Daniels	3,193	....	3,193	923,520	.3
Dawson	5,952	1,160	7,112	1,509,120	.5
Deer Lodge*	103,524	23,898	127,422	263,480	48.4
Deer Lodge	79,373	50,147	129,520	208,840	62.0
Fallon	378	....	378	1,045,120	(2)
Fergus	341,040	58,488	399,528	2,720,000	14.7
Flathead*	1,610,082	1,294,644	2,904,726	3,313,280	87.7
Gallatin	528,651	224,401	753,052	1,610,880	46.7
Garfield	69,611	....	69,611	3,067,520	2.3
Glacier	110,519	289,306	399,825	1,903,360	21.0
Golden Valley	19,921	14,342	34,263	753,920	4.5
Granite*	648,574	157,320	805,894	1,098,880	73.3
Hill	7,929	....	7,929	1,884,160	.4
Jefferson	427,083	52,735	479,818	1,056,640	45.4
Judith Basin	211,045	84,865	295,910	1,203,200	24.6
Lake*	444,879	91,767	536,646	960,000	55.9
Lewis and Clark*	234,281	159,123	393,404	443,350	88.7
Lewis and Clark	590,409	281,029	871,438	1,782,570	48.9
Liberty	2,809	2,764	5,573	933,760	.6
Lincoln*	1,845,865	422,811	2,268,676	2,377,600	95.4
McCone	635	....	635	1,688,320	(2)
Madison	404,695	201,032	605,727	2,259,200	26.8
Meagher	445,361	52,941	498,302	1,506,560	33.1
Mineral*	539,444	220,706	760,150	782,720	97.1
Missoula*	1,193,795	270,607	1,464,402	1,682,560	87.0
Musselshell	247,381	....	247,381	1,207,040	20.5
Park	398,100	307,342	705,442	1,681,280	42.0
Petroleum	22,668	....	22,668	1,064,960	2.1
Phillips	26,559	2,539	29,098	3,368,960	.9
Pondera	60,474	10,590	71,064	1,051,520	6.8
Powder River	196,791	2,189	198,980	2,102,400	9.5
Powell*	546,554	414,209	960,763	1,495,680	64.2
Prairie	2,170	....	2,170	1,105,280	.2
Ravalli*	544,156	691,669	1,235,825	1,525,760	81.0
Richland	5,889	....	5,889	1,321,600	.4
Roosevelt	765	....	765	1,526,400	.1
Rosebud	151,941	661	152,602	3,220,480	4.7
Sanders*	1,108,694	346,787	1,455,481	1,799,040	80.9
Sheridan	1,538	....	1,538	1,088,000	.1
Silver Bow*	88,990	16,405	105,395	235,810	44.7
Silver Bow	109,202	12,390	121,592	222,430	54.7
Stillwater	124,154	98,084	222,238	1,150,080	19.3
Sweet Grass	172,796	96,339	269,135	1,181,440	22.8
Teton	189,925	45,901	235,826	1,468,160	16.1

TABLE 20.—*Relationship of forest land area of Montana to total land area, by county, 1949—Continued*

County [1]	Forest land			Total land area	Percent of total land area in forest land
	Commercial	Noncommercial and reserved	Total		
	Acres	*Acres*	*Acres*	*Acres*	
Toole	13,282	....	13,282	1,257,600	1.1
Treasure	24,418	....	24,418	629,760	3.9
Valley	14,300	....	14,300	3,252,480	.4
Wheatland	25,256	28,593	53,849	912,000	5.9
Wibaux	5,436	....	5,436	568,960	1.0
Yellowstone	58,412	175	58,587	1,686,400	3.5
Yellowstone Park	....	139,980	139,980	172,100	81.3
Eastern Montana	6,847,664	2,492,604	9,340,268	77,664,020	12.0
Western Montana	8,908,838	4,109,946	13,018,784	15,978,160	81.5
Total	15,756,502	6,602,550	22,359,052	93,642,180	23.9

[1] An asterisk indicates areas west of the Continental Divide; all other areas are east of the Divide.

[2] Less than 0.05 percent.

TABLE 21.—*Timber volume on commercial forest land in Montana, by counties, 1949*

County [1]	Live saw timber [2]	Live all timber [3]
	M board feet	*M cubic feet*
Beaverhead	2,276,123	1,288,148
Big Horn	113,345	71,534
Blaine	60,835	26,570
Broadwater	423,233	201,274
Carbon	107,615	73,058
Carter	111,331	33,838
Cascade	178,755	86,884
Chouteau	22,372	9,390
Custer	26,693	11,146
Daniels	42	233
Dawson	6,032	3,369
Deer Lodge*	44,360	21,200
Deer Lodge	115,149	87,678
Fallon	664	183
Fergus	225,326	85,695
Flathead*	8,843,064	1,882,200
Gallatin	2,351,088	952,423
Garfield	21,463	13,954
Glacier	49,720	20,027
Golden Valley	16,508	9,239
Granite*	1,328,123	418,800
Hill	6,217	3,728
Jefferson	714,912	475,308
Judith Basin	323,880	120,578
Lake*	2,406,135	537,400
Lewis and Clark*	604,764	157,700
Lewis and Clark	1,462,369	595,730
Liberty	3,550	1,859
Lincoln*	11,116,472	2,543,000
Mc Cone	3,494	774
Madison	1,360,846	580,579
Meagher	1,630,647	673,614
Mineral*	1,943,593	510,900
Missoula*	4,794,840	1,160,500
Musselshell	273,844	105,713
Park	2,363,149	760,760
Petroleum	5,941	3,867
Phillips	31,562	16,361
Pondera	112,943	43,891
Powder River	209,038	78,816
Powell*	1,366,749	404,800
Prairie	11,939	2,644
Ravalli*	2,213,928	487,400
Richland	29,848	6,717
Roosevelt	1,021	357
Rosebud	119,066	50,682
Sanders*	4,963,049	1,147,000
Sheridan	67	98
Silver Bow*	63,685	32,700
Silver Bow	439,713	161,647
Stillwater	122,606	70,944
Sweet Grass	564,161	209,085
Teton	201,076	128,315
Toole	6,494	3,466
Treasure	19,772	7,995
Valley	45,849	11,367
Wheatland	37,509	20,799
Wibaux	903	315
Yellowstone	62,215	23,982
Eastern Montana	16,270,925	7,134,634
Western Montana	39,688,762	9,303,600
Total	55,959,687	16,438,234

[1] An asterisk indicates areas west of the Continental Divide; all other areas are east of the Divide.

[2] Trees 11.0 inches and larger in diameter, measured by International ¼-inch rule.

[3] The volume, excluding bark, of sound trees and the sound volume of cull trees from 1-foot stump to a 4.0-inch minimum top diameter including the sound volume of limbwood for hardwood species to a 4.0-inch minimum top diameter.

TABLE 22.—*Annual lumber production reported in Montana, by species, for specified years, 1869–1948* [1]

Species	1869	1879	1889 (30 mills)	1899 (69 mills)	1904 (36 mills)	1905 (23 mills)	1906 (84 mills)	1907 (130 mills)	1908 (173 mills)	1909 (179 mills)	1910 (140 mills)	1911 (126 mills)	1912 (118 mills)
Softwood:	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*
Cedar	....	....	....	....	....	3,000	195	10	2,030	60	126	3	848
Douglas-fir	5,000	9,000	30,000	61,931	49,404	6,132	41,537	34,703	38,825	43,270	53,070	36,784	39,325
Hemlock	....	....	....	....	....	5,000	235	....	....	....	1,201	....	10
Ponderosa pine	7,000	10,000	60,000	153,467	138,476	101,998	165,849	164,746	144,587	146,890	135,817	96,654	94,093
White pine	1,000	2,000	2,000	4,375	....	20,561	5,850	2,615	6,287	1,671	3,090	5,311	7,363
Spruce	....	....	....	415	17,900	155	4,025	7,936	7,201	6,837	10,273	2,803	7,432
Larch	....	....	....	34,197	3,400	39,089	91,488	107,684	106,095	104,130	99,283	80,145	120,779
Grand fir	....	....	....	....	....	....	14,464	25,999	6,281	2,647	13,589	2,917	560
Lodgepole pine	....	....	....	....	....	....	....	....	....	2,567	2,380	3,348	1,959
Other	....	....	1,000	....	27,250	....	....	....	....	....	....	....	....
Total	13,000	21,000	93,000	254,385	236,430	175,935	323,643	343,693	311,306	308,072	318,829	227,970	271,869
Hardwood:													
Cottonwood	....	....	....	....	....	....	200	121	227	510	260	446	305
Oak	....	....	....	1,300	....	....	....	....	....	....	....	....	....
Other	....	....	1,000	....	....	13,356	4,884	....	....	....	....	....	....
Total	....	....	1,000	1,300	....	13,356	5,084	121	227	510	260	446	305
Total, all species	13,000	21,000	94,000	255,685	236,430	189,291	328,727	343,814	311,533	308,582	319,089	228,416	272,174

Species	1913 (109 mills)	1914 (124 mills)	1915 (94 mills)	1916 (103 mills)	1917 (122 mills)	1918 (98 mills)	1919 (125 mills)	1920 (124 mills)	1921 (120 mills)	1922 (100 mills)	1923 (117 mills)	1924 (100 mills)
Softwood:	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*
Cedar	80	1,005	....	2,612	25	....	189	1,846	....	20	101	780
Douglas-fir	63,494	51,061	41,464	56,845	38,600	34,906	40,675	55,670	27,762	51,966	76,002	54,050
Hemlock	298	....	....	....	....	....	29	....	....	....	20	731
Ponderosa pine	120,414	134,568	118,920	138,206	150,905	169,956	108,548	173,507	102,342	136,393	167,468	137,358
White pine	24,606	17,537	27,330	10,497	4,974	4,207	371	5,061	710	351	7,539	9,484
Spruce	7,623	7,666	13,266	6,790	6,437	6,773	34,064	21,573	491	6,444	12,589	4,011
Larch	137,703	101,771	115,001	163,829	135,734	114,250	101,714	112,400	81,053	105,415	159,029	141,075
Grand fir	2,330	465	6,510	3,408	9,645	4,523	576	22,891	29	578	1,578	323
Lodgepole pine	1,199	3,677	1,684	1,631	986	729	352	15,603	1,320	2,279	2,097	2,518
Total	357,747	317,750	324,175	383,818	347,306	335,344	286,518	408,551	213,707	303,446	426,423	350,330
Hardwood: Cottonwood	227	92	158	66	190	467	860	1,116	282	12	494	5
Total, all species	357,974	317,842	324,333	383,884	347,496	335,811	287,378	409,667	213,989	303,458	426,917	350,335

TABLE 22.—*Annual lumber production reported in Montana, by species, for specified years, 1869–1948* [1]—*Continued*

Species	1925 (120 mills)	1926 (122 mills)	1927 (126 mills)	1928 (119 mills)	1929 (126 mills)	1930 (114 mills)	1931 (86 mills)	1932 (72 mills)	1933 (89 mills)	1934 (105 mills)	1935 (116 mills)	1936 (126 mills)
	M ft. b. m.	*M ft. b. m.*	*M ft. b. m.*	*M ft b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*
Softwood:												
Cedar	757	213	1	3	36	......	37	....	20	....	5	100
Douglas-fir	74,003	67,251	79,883	72,827	72,830	45,585	29,469	15,795	13,693	26,473	34,039	51,395
Hemlock	2,683	1,371	8	214	....	....	....	....	....	....	....	....
Ponderosa	159,238	172,000	164,197	168,396	170,047	133,709	64,541	54,897	72,196	79,549	114,454	130,507
White pine	9,915	15,178	12,623	18,501	21,697	25,600	17,857	2,705	4,776	7,092	15,384	23,669
Spruce	5,368	7,099	5,979	7,721	16,183	13,343	3,661	4,492	9,241	7,298	12,089	13,510
Larch	133,393	112,217	130,647	118,175	104,818	77,889	41,792	32,620	24,527	50,189	56,336	74,241
Grand fir	2,233	1,187	856	232	213	70	110	30	35	100	40	837
Lodgepole pine	1,254	1,977	2,013	1,733	2,842	774	741	479	638	989	1,228	974
Total	388,844	378,493	396,207	387,802	388,666	296,970	158,208	111,018	125,126	171,690	233,575	295,233
Hardwood: Cottonwood	10	205	60	77	45	20	....	30	....	151	58	....
Total, all species	388,854	378,698	396,267	387,879	388,711	296,990	[2]158,213	111,048	125,126	171,841	233,633	295,233

Species	1937 (146 mills)	1938 (140 mills)	1939 (168 mills)	1940 (168 mills)	1941 (265 mills)	1942 (249 mills)	1943 (228 mills)	1944 (256 mills)	1945 (253 mills)	1946 (401 mills)	1947 (407 mills)	1948 (434 mills)
	M ft. b. m.	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*
Softwood:												
Cedar	100	36	103	154	12	....	25	38	....	17	82	1,068
Douglas-fir	57,899	39,929	39,240	62,336	86,518	96,663	75,953	89,720	67,532	99,573	114,147	210,896
Hemlock	....	16	....	....	....	5	....	....	....	....	140	196
Ponderosa pine	154,709	106,902	130,060	145,684	166,100	177,497	173,622	180,042	144,346	150,405	200,923	223,569
Grand pine	20,186	21,163	29,939	26,962	18,135	18,707	9,618	9,048	3,815	7,699	6,145	13,464
Spruce	14,772	6,373	5,447	12,386	13,010	20,584	16,996	26,365	13,824	11,933	9,836	16,705
Larch	84,686	45,439	63,738	75,493	87,549	117,311	145,396	140,985	110,092	138,900	162,438	129,259
Grand fir	1,332	357	222	87	711	56	161	5	425	142	1,356	106
Lodgepole pine	1,354	1,350	2,202	2,213	1,902	2,244	1,680	2,217	1,589	4,820	4,674	2,619
Total	335,038	221,565	270,951	325,315	373,937	433,067	423,451	448,420	341,623	413,489	499,741	597,882
Hardwood:												
Cottonwood	7	14	130	23	33	22	69	78	126	368	216	60
Birch	....	....	15	....	....	....	....	....	....	2	....	....
Other	....	....	....	....	....	....	....	....	....	....	2	2
Total	7	14	145	23	33	22	69	78	126	370	218	62
Total, all species	335,045	221,579	271,096	325,338	373,970	433,089	423,520	448,498	341,749	413,859	499,959	597,944

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[1] Source: 1869-1946, U. S. Dept. Agr. Misc. Pub. 669, Lumber Production in the United States—1799-1946; 1947, U. S. Bureau of the Census, Census of Manufactures—1947; 1948, Forest Service data.

[2] Includes 5 M feet board measure of birch.

TABLE 23.—*Lumber production and number of active sawmills in Montana, by mill size, for specified years, 1921–48* [1]

Year	Total lumber production	Total mills	Large (10,000 M feet board measure and over)			Medium (1,000 to 9,999 M feet board measure)			Small (999 M feet board measure and less)		
			Active mills	Lumber production	Relation to total production	Active mills	Lumber production	Relation to total production	Active mills	Lumber production	Relation to total production
	M ft. b. m.	*Number*	*Number*	*M ft. b. m.*	*Percent*	*Number*	*M ft. b. m.*	*Percent*	*Number*	*M ft. b. m.*	*Percent*
1921	214,908	159	7	160,878	75	12	32,843	15	140	21,187	10
1926	379,563	161	7	286,934	76	19	71,181	19	135	21,448	5
1931	159,491	139	5	124,288	78	7	21,540	14	127	13,663	8
1936	296,866	198	5	188,176	63	17	84,346	29	176	24,344	8
1941	373,970	265	4	242,375	65	28	90,379	24	233	41,216	11
1946	413,859	401	3	158,725	38	67	192,905	47	331	62,229	15
1947	499,959	407	4	202,063	41	77	226,953	45	326	70,943	14
1948	597,944	434	5	208,930	35	87	286,386	48	342	102,628	17

[1] Total production and number of sawmills for 1921, 1926, 1931, and 1936 exceed those shown in table 22 because table 22 does not include production and number of mills that cut less than 50 M feet, board measure, in these years.

TABLE 24.—*Lumber production and number of active sawmills in Montana, by mill size, 1945–47* [1]

Mill size and annual production rate (M ft. b. m.)	1945		1946		1947	
	Active mills	Production	Active mills	Production	Active mills	Production
Small:	*Number*	*M ft. b. m.*	*Number*	*M ft. b. m.*	*Number*	*M ft. b. m.*
1– 49	76	1,811	101	2,332	80	1,799
50–199	64	6,482	129	13,657	135	14,716
200–499	38	11,048	65	20,548	65	20,725
500–999	22	14,315	36	25,692	46	33,703
Medium:						
1,000–2,999	31	53,115	43	71,931	48	85,453
3,000–4,999	10	39,943	14	50,950	18	67,845
5,000–9,999	8	52,268	10	70,024	11	73,655
Large:						
10,000–14,999	1	[2]162,767	0	....	1	[2]202,063
15,000–24,999	1	....	0	....	....	....
25,000–49,999	0	....	1	[2]158,725	1	....
50,000 and over	2	....	2	....	2	....
Total	253	341,749	401	413,859	407	499,959

[1] Data from Bureau of Census releases.

[2] In order to avoid disclosing operations of individual establishments, this total includes the production of all active mills in this size class.

TABLE 25.—*Number of poles produced annually in Montana, by species, 1937 and 1946–49*

Species	1937	1946	1947	1948	1949
Lodgepole pine	3,214	265,877	269,141	114,705	172,108
Western redcedar	24,425	8,769	16,984	17,841	15,408
Larch	....	26,476	32,704	29,695	32,546
Douglas-fir	1,608	....	5,905	4,615	1,753
Miscellaneous	....	200	....	....	....
Total	29,247	301,322	324,734	166,856	221,815

Table 26.—*Annual production of Christmas trees, cross ties, shingles, and lath in Montana, 1925–49*

Year	Christmas trees	Sawed cross ties[1]	Shingles	Lath
	Number	*Number*	*Squares*	*M pieces*
1925	....	1,225,000	3,387	32,209
1926	....	....	481	32,306
1927	....	1,054,796	300	19,419
1928	....	959,175	252	15,416
1929	....	915,895	210	17,003
1930	....	824,515	660	14,488
1931	....	613,143	385	6,741
1932	....	670,000	447	4,362
1933	....	525,000	430	7,449
1934	....	....	750	8,705
1935	....	....	1,587	10,416
1936	1,242,500	....	6,111	13,481
1937	1,534,500	....	3,366	16,869
1938	1,676,000	554,540	5,912	11,856
1939	1,967,350	....	10,608	12,530
1940	2,338,350	1,237,668	12,512	11,747
1941	3,082,650	1,398,968	12,410	11,466
1942	2,203,750	2,319,978	9,491	11,691
1943	3,102,480	2,239,584	3,081	8,024
1944	2,755,750	2,090,428	425	7,300
1945	2,723,500	1,302,238	1,024	2,680
1946	3,299,400	1,008,619	1,942	5,361
1947	2,515,640	1,336,555	....	....
1948	3,098,886	....	....	....
1949	3,256,956	....	....	....

[1] Production of sawed cross ties is included in total volume of lumber production, table 22.

Table 27.—*Distribution of Montana lumber shipments, by section and State, specified years, 1924–45* [1]

Section and state	1924	1936	1938	1945
	M ft. b. m.	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*
Montana	118,249	169,732	134,673	192,934
West:				
Arizona	....	....	....	61
California	69	....	5	575
Colorado	10,562	3,044	1,780	3,947
Idaho	2,090	3,971	1,703	3,886
Nevada	....	....	....	15
New Mexico	....	....	....	119
Oregon	....	63	....	....
Utah	2,166	1,938	2,338	7,580
Washington	1,738	3,081	122	4,843
Wyoming	6,397	3,489	5,129	2,402
Total	23,022	15,586	11,077	23,428
Middle West:				
Illinois	35,709	16,830	14,572	24,920
Indiana	745	857	848	3,721
Iowa	15,473	11,696	12,597	12,336
Kansas	2,619	381	647	2,361
Michigan	12,130	8,136	3,437	7,971

Table 27.—*Distribution of Montana lumber shipments, by section and State, specified years, 1924–45* [1]—*Continued*

Section and state	1924	1936	1938	1945
	M ft. b. m.	*M ft. b. m.*	*M ft. b. m.*	*M ft. b. m.*
Middle West—Con.				
Minnesota	37,019	13,059	7,950	29,430
Missouri	4,866	2,974	2,956	3,557
Nebraska	10,309	2,677	1,698	4,880
North Dakota	5,282	13,205	2,040	10,000
Ohio	1,945	3,048	3,686	2,722
South Dakota	3,569	949	1,021	2,801
Wisconsin	11,798	4,610	3,278	11,758
Total	141,464	78,422	54,730	116,457
Northeast:				
Connecticut	7,061	3,273	2,879	1,109
Delaware	....	178	355	....
Maine	69	90	178	904
Maryland and District of Columbia	48	548	627	299
Massachusetts	1,526	1,762	720	476
New Hampshire	192	103	21	61
New Jersey	775	3,513	3,891	1,615
New York	10,905	9,210	8,947	4,704
Pennsylvania	13,590	6,828	5,798	11,530
Rhode Island	263	237	148	167
Vermont	165	109	105	34
West Virginia	1,563	123	153	155
Total	36,157	25,974	23,822	21,054
South:				
Alabama	....	20	26	20
Arkansas	....	....	....	....
Florida	....	....	....	48
Georgia	....	....	....	....
Kentucky	....	....	3	304
Louisiana	....	....	....	....
Mississippi	....	....	....	103
North Carolina	....	....	26	....
Oklahoma	145	49	71	1,251
South Carolina	....	....	....	....
Tennessee	25	25	12	29
Texas	....	25	9	687
Virginia	25	63	429	172
Total	195	182	576	2,614
Total domestic	319,087	289,896	224,878	356,487
Exports	....	....	18	990
Total	319,087	289,896	224,896	357,477

[1] Source: 1936. Lumber Distribution and Consumption for 1936, table 5, p. 19. U. S. Dept. Agr. Forest Service. 1938.

1938. U. S. Dept. Agr. Misc. Fub. 413, table 12, p. 26.

1945. Distribution of Lumber from Sawmills in Western States, table 3. U. S. Dept. Agr. Forest Service. 1947.

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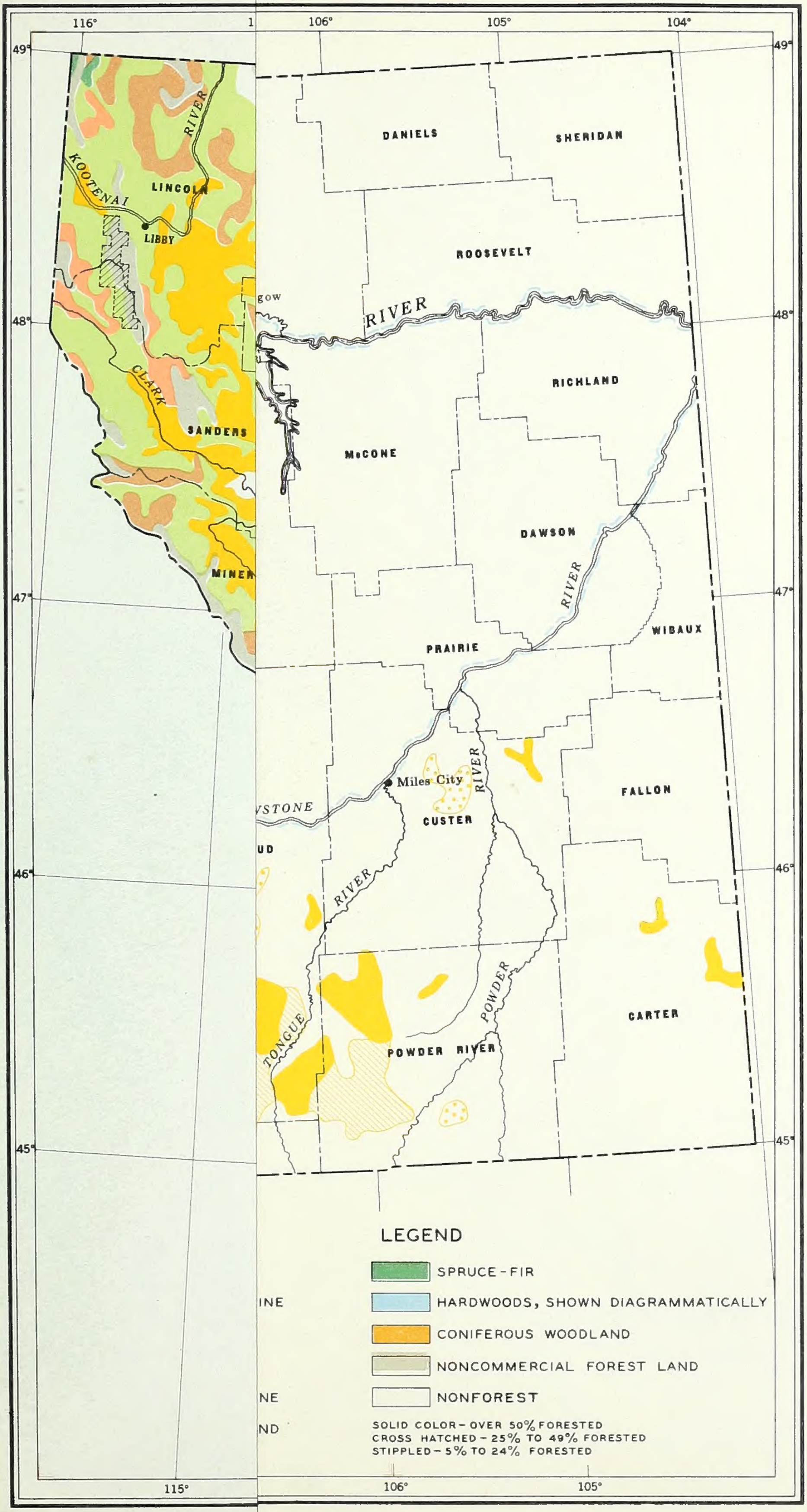
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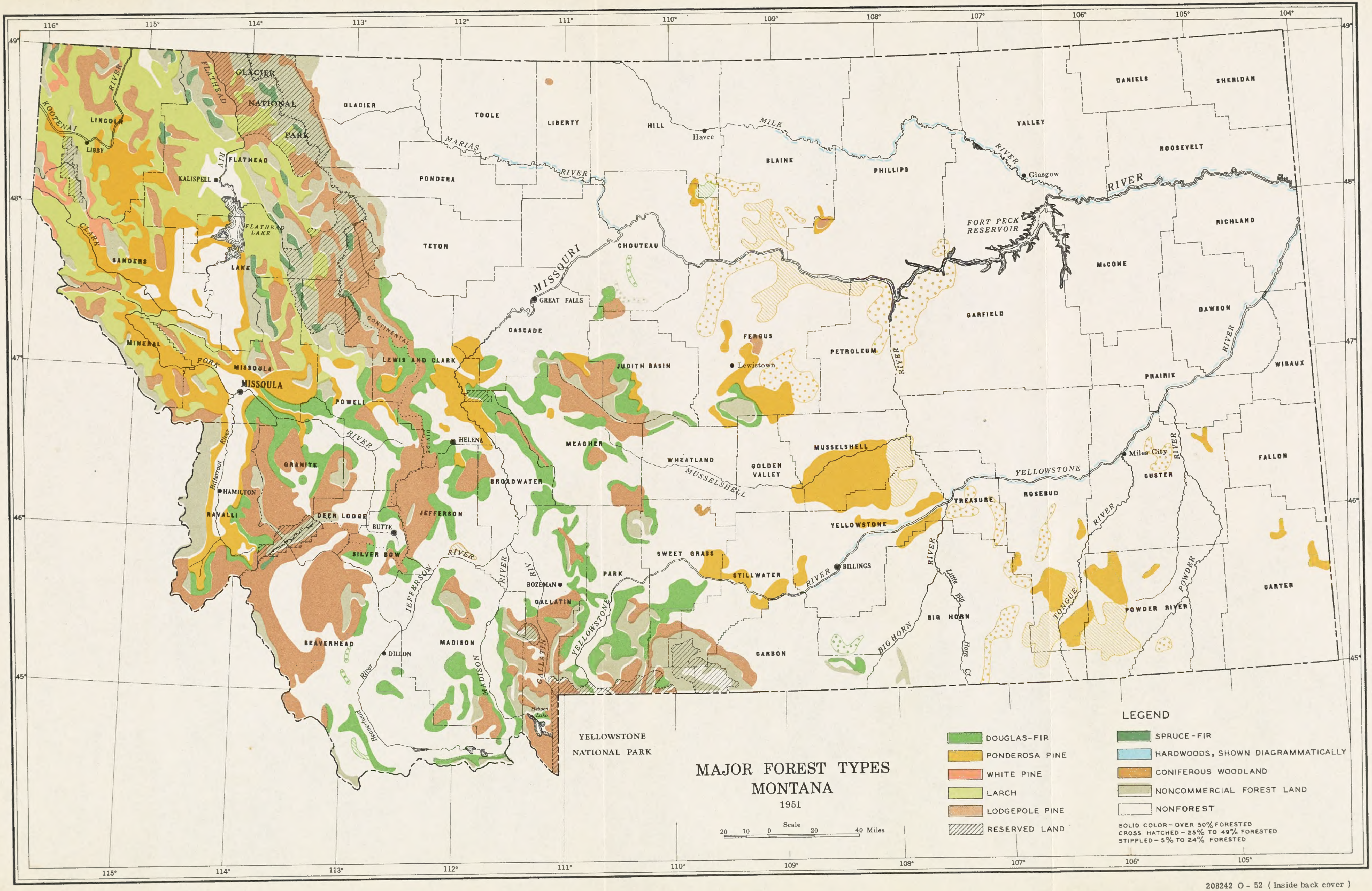

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